

CONTENTS

Contributors

vii

Laser Sources

<u>A. E. Siegman: INTERACTION OF RADIATION WITH MATTER</u>	1
Introduction	1
The Classical Electron Oscillator Model	1
Conversion of Classical Oscillator Results to Real	
Atomic Results	7
The Quantum Mechanical Density Matrix Method	11
Quantum Derivation of the Atomic Response	20
Rate Equations	28
Two-level Rate Equation and Saturation	34
Reaction of atoms back on applied signals	38
Lumped-circuit Derivation	38
Cavity Derivation	44
Traveling-wave Interactions	50
Other forms for the atomic and cavity equations	57
The Resonant-dipole Two-level Equations	57
Conversion to Phasor Form	59
Lamb's Form of the Cavity Equations	62
The generalized Bloch Equations	65
<u>L. Ronchi: THEORY OF OPEN RESONATORS</u>	71
Open Structures as Resonators in Laser Technique	71
Definition of Mode of an Open Resonator	74
Evaluation of the Modes of an Open Structure	76
Other Methods of Evaluation of the Modes of an Open	
Resonator	89
Mode Volume, Q-Number and Mode Selectivity	95

<u>H. Kressel:</u>	SEMICONDUCTOR LASERS	101
Introduction		101
General Semiconductor Laser concepts		101
Device Design Considerations		108
Laser Technology		115
Performance of various Laser Structures		118
Semiconductor Laser Applications		127
<u>F. P. Schaefer:</u>	LIQUID LASERS	135
Spectroscopic Properties of Organic Dyes		136
Laser-pumped Dye Lasers		154
Flashlamp-pumping of Dyes		166
Tuning methods		172
Mode-locking in Dye Lasers		178
<u>A. Ferrario, A. Sona:</u>	GASEOUS LASERS	183
Introduction and General Remarks		183
Excitation Processes		184
Characteristics of the Emission Line		185
Neutral Atoms Lasers: the He-Ne System		189
Ion Laser: Ar^+ , Kr^+ , Xe^+		191
Metallic Vapours Lasers: He-Cd, He-Se		196
Molecular Lasers: the CO_2 - N_2 - He System		199
<u>O. Svelto:</u>	Q-SWITCHING AND MODE-LOCKING	207
Rate-Equations		207
Q-Switching		209
Mode-locking		215
<u>D. Roess:</u>	CW SOLID STATE LASERS	221
Power Balance		221
Material Parameters		224
Pump Light Sources		228
Pump Systems		230

Inhomogeneities introduced by Pump Systems	233
Practical Results with YAG-Lasers	235
Ruby and YAG Material Availability	236
Quasi CW Lasers	243
 <u>Applications</u>	
<u>G. Toraldo di Francia: THEORY OF HOLOGRAPHY</u>	253
Introduction	253
Wave Equation	253
Photographic Process	261
<u>V. Russo Checcacci: APPLICATION OF HOLOGRAPHY</u>	269
Introduction	269
Holographic Interferometry	271
Data Storage and Retrieval	279
Optical Data Processing	284
Non-Optical Holography	291
<u>B. Daino: INFORMATION PROCESSING WITH OPTICAL METHODS</u>	295
Introduction	295
Fourier-transform Methods in Optical Systems	295
Image and Frequency Planes in Optical Systems	302
Two simple Examples of Spatial Filtering	307
Pattern Recognition as a Signal Detection Problem	311
Optical Evaluation of Temporal Frequencies Spectra	315
Measurement of the Spatial Coherence Function using the Reversing point Interferometer	319
<u>A. Consortini: ATMOSPHERIC PROPAGATION</u>	323
Introduction	323
Statistical Description of fluctuating Quantities	324

Description of the Turbulence	325
The Refractive Index Fluctuations due to Turbulence	326
Propagation	328
Phase Fluctuations of Plane Waves in the Geometrical Optics Approximation	331
Amplitude Fluctuations of Plane Waves in the Geometrical Optics Approximation	335
Method of the smooth Perturbations	339
Open Problems and present State of Propagation Theory	342
Appendix	347
<u>M. Bertolotti: EFFECTS OF ATMOSPHERE ON THE PROPAGATION OF LASER BEAMS</u>	349
Introduction	349
Atmospheric Absorption and Scattering	349
Atmospheric Turbulence	360
Experimental Methods	389
<u>D. Sette, B. Daino: TRANSMISSION OF INFORMATION WITH LASER BEAMS</u>	415
Introduction	415
Some Information Theory Elements	415
Structure of a Laser Communication Link	419
The Quantum Receiver and the Detection of Digital Signals	421
The Detection of Analog Signals	429
The Heterodyne Receiver	431
Some Experiments in Optical Communications	434
Conclusions	436
<u>E. Gatti, S. Donati: BEAM MODULATION TELEMETRY</u>	441
Introduction	441
Preliminary Considerations	442
Beam Modulation Telemetry	443

<u>C.A. Sacchi</u> : SELF-FOCUSING AND SELF-TRAPPING OF INTENSE LASER BEAMS	561
Introduction	561
The Self-Focusing and Self-Trapping Effects	562
Experimental Results	565
Interpretation of the Spectra	570
Physical Mechanisms Responsible for Filaments Formation	573
<u>S. Martellucci</u> : PLASMA GENERATION AND DIAGNOSTICS BY LASERS	579
Introduction	579
Plasma Diagnostics by Lasers	580
Plasma Production by Lasers	593
Laser Produced Plasma from Gases	595
Laser Produced Plasma from Solids	600
Final Remarks	604
<u>M. Giglio</u> : LIGHT SCATTERING FROM SIMPLE FLUIDS AND BINARY MIXTURES NEAR THE CRITICAL POINT	609
Introduction	609
Static Properties	610
Dynamic Properties	621
The Rayleigh Component	623
The Brillouin Components	625