

CONTENTS

1 INTRODUCTION 1

- 1-1 Emission and Absorption of Light by Gas Discharges 3
- 1-2 Gas-Laser Spectroscopy 6
- 1-3 Helium-Neon Lasers 7
- 1-4 Ion Lasers 10
- 1-5 Carbon-Dioxide Lasers 11

2 INTERACTION OF RADIATION AND MATTER 14

- 2-1 Method of Approach 14
- 2-2 Interaction of an Atom with a Radiation Field 16
- 2-3 Density Matrix 18
- 2-4 Rate-Equation Approximation 22
- 2-5 Dispersion Theory 24
- 2-6 Line Broadening 26

3 LAMB'S THEORY OF GAS LASERS 36

- 3-1 Laser Cavities 36
- 3-2 Self-Consistency Equations 37
- 3-3 General Discussion of Gas-Laser Oscillations 39
- 3-4 Threshold Conditions 42
- 3-5 Single-mode Laser 44
- 3-6 Multimode Laser 48

4	TRANSVERSE-MODE STRUCTURE	61
4-1	Plane-parallel Cavity	62
4-2	Confocal Cavity	71
4-3	General Curved-mirror Cavities	81
4-4	Choice of Mirror Curvatures for Gas-Laser Cavities	84
4-5	Resonance Conditions in General Curved-mirror Cavities	87
4-6	Propagation-circle Methods for Gaussian Beams	88
4-7	Algebraic Methods for Gaussian Beams	93
4-8	Special Topics Concerning Transverse Modes	95
5	LONGITUDINAL-MODE STRUCTURE	100
5-1	Single-longitudinal-mode Lasers	101
5-2	Phase-locked Lasers	103
5-3	Frequency Stabilization of Gas Lasers	109
6	OUTPUT POWER OF GAS LASERS	113
6-1	Single-mode Gas Lasers	113
6-2	Multimode Gas Lasers	118
7	CONSTRUCTION OF GAS LASERS	123
7-1	Gas-Laser Plasma Tubes	123
7-2	Cathodes for Plasma Tubes	132
7-3	Vacuum Processing of Plasma Tubes	134
7-4	Power Supplies for Gas Lasers	141
7-5	Mirrors and Windows for Gas Lasers	146
7-6	Mechanical Construction of Gas Lasers	148
1	APPENDIX: SOME FORMULAS FROM ELECTROMAGNETIC THEORY	151
2	APPENDIX: PLASMA DISPERSION FUNCTION	156
	INDEX	158