#### CONTENTS

# PART I

#### Introduction

#### CHAPTER 1 BASIC PRINCIPLES OF LASERS AND NONLINEAR OPTICAL EFFECTS By Edward H. Piepmeier

# 3

#### PART II

#### Selected Methods that Use Various Detection Schemes

| CHAPTER 2 | LASER-EXCITED ATOMIC AND IONIC<br>FLUORESCENCE IN FLAMES AND PLASMAS<br>By J. D. Winefordner and N. Omenetto | 31  |
|-----------|--------------------------------------------------------------------------------------------------------------|-----|
| CHAPTER 3 | LASER-ENHANCED IONIZATION IN FLAMES<br>By Robert B. Green                                                    | 75  |
| CHAPTER 4 | <b>DETECTION OF SMALL NUMBERS OF</b><br><b>ATOMS AND MOLECULES</b><br><i>By C. Th. J. Alkemade</i>           | 107 |
| CHAPTER 5 | <b>OPTOACOUSTIC SPECTROSCOPY</b><br>By Andrew C. Tam                                                         | 163 |
| CHAPTER 6 | <b>INFRARED ABSORPTION SPECTROSCOPY</b><br>By Edward S. Yeung                                                | 187 |

#### CONTENTS

#### PART III

## Methods With Improved Spectral Resolution

| CHAPTER 7                                                   | <b>CRYOGENIC MOLECULAR FLUORESCENCE</b><br><b>SPECTROMETRY</b><br><i>By E. L. Wehry</i>                                                           | 211 |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| CHAPTER 8                                                   | LINEAR AND NONLINEAR SITE-SELECTIVE<br>LASER SPECTROSCOPY<br>By J. C. Wright, D. C. Nguyen, J. K. Steehler,<br>M. A. Valentini, and R. J. Haskell | 273 |
| PART IV<br>Selected Multiphoton and Multiwavelength Methods |                                                                                                                                                   |     |
| CHAPTER 9                                                   | <b>TWO-PHOTON EXCITED FLUORESCENCE</b><br>By A. C. Koskelo and M. J. Wirth                                                                        | 295 |
| CHAPTER 10                                                  | RAMAN AND RELATED METHODS IN                                                                                                                      |     |

| CHAFTER IV | KAMAN AND KELATED METHODS IN |     |
|------------|------------------------------|-----|
|            | CHEMICAL ANALYSIS            | 315 |
|            | By Edward S. Yeung           |     |

### PART V

Methods Based on Special Characteristics of Lasers

| CHAPTER 11 | <b>REMOTE SENSING WITH LASERS</b><br>By R. M. Measures                                   | 367 |
|------------|------------------------------------------------------------------------------------------|-----|
| CHAPTER 12 | <b>INTRACAVITY-ENHANCED SPECTROSCOPY</b><br>By Edward H. Piepmeier                       | 431 |
| CHAPTER 13 | THERMAL LENS EFFECT<br>By Joel M. Harris                                                 | 451 |
| CHAPTER 14 | PICOSECOND SPECTROSCOPY IN<br>ANALYTICAL CHEMISTRY<br>By M. J. Wirth and G. J. Blanchard | 477 |

xii

|            | CONTENTS                                                                             | xiii |
|------------|--------------------------------------------------------------------------------------|------|
| CHAPTER 15 | ANALYTICAL LIMITS OF<br>ELECTROPHORETIC LIGHT SCATTERING<br>By Bennie R. Ware        | 493  |
| CHAPTER 16 | <b>LASER FLOW CYTOMETRY</b><br>By Scott J. Hein and Lawrence C. Thomas               | 521  |
|            | PART VI<br>Lasers With Other Methods                                                 |      |
| CHAPTER 17 | LASER SPECTROSCOPY FOR DETECTION IN<br>CHROMATOGRAPHY<br>By Edward S. Yeung          | 557  |
| CHAPTER 18 | LASER IONIZATION TECHNIQUES FOR<br>ANALYTICAL MASS SPECTROMETRY<br>By Robert S. Houk | 587  |
| CHAPTER 19 | LASER ABLATION FOR ATOMIC<br>SPECTROSCOPY<br>By Edward H. Piepmeier                  | 627  |
|            | INDEX                                                                                | 671  |