

1. Record Nr.	UNINA9910821090003321
Autore	Milonni Peter W
Titolo	Laser physics / / Peter W. Milonni, Joseph H. Eberly
Pubbl/distr/stampa	Hoboken, NJ, : John Wiley & Sons, c2010
ISBN	1-282-68713-1 9786612687136 0-470-40970-3
Edizione	[Second edition.]
Descrizione fisica	1 online resource (849 p.)
Altri autori (Persone)	Eberly J. H. <1935->
Disciplina	621.36/6
Soggetti	Lasers Nonlinear optics Physical optics
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Description based upon print version of record.
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Intro -- LASER PHYSICS -- CONTENTS -- Preface -- 1 Introduction to Laser Operation -- 1.1 Introduction -- 1.2 Lasers and Laser Light -- 1.3 Light in Cavities -- 1.4 Light Emission and Absorption in Quantum Theory -- 1.5 Einstein Theory of Light-Matter Interactions -- 1.6 Summary -- 2 Atoms, Molecules, and Solids -- 2.1 Introduction -- 2.2 Electron Energy Levels in Atoms -- 2.3 Molecular Vibrations -- 2.4 Molecular Rotations -- 2.5 Example: Carbon Dioxide -- 2.6 Conductors and Insulators -- 2.7 Semiconductors -- 2.8 Semiconductor Junctions -- 2.9 Light-Emitting Diodes -- 2.10 Summary -- Appendix: Energy Bands in Solids -- Problems -- 3 Absorption, Emission, and Dispersion of Light -- 3.1 Introduction -- 3.2 Electron Oscillator Model -- 3.3 Spontaneous Emission -- 3.4 Absorption -- 3.5 Absorption of Broadband Light -- 3.6 Thermal Radiation -- 3.7 Emission and Absorption of Narrowband Light -- 3.8 Collision Broadening -- 3.9 Doppler Broadening -- 3.10 The Voigt Profile -- 3.11 Radiative Broadening -- 3.12 Absorption and Gain Coefficients -- 3.13 Example: Sodium Vapor -- 3.14 Refractive Index -- 3.15 Anomalous Dispersion -- 3.16 Summary -- Appendix: The Oscillator Model and Quantum Theory -- Problems -- 4 Laser Oscillation: Gain and Threshold -- 4.1 Introduction -- 4.2 Gain and Feedback -- 4.3 Threshold -- 4.4 Photon

Rate Equations -- 4.5 Population Rate Equations -- 4.6 Comparison with Chapter 1 -- 4.7 Three-Level Laser Scheme -- 4.8 Four-Level Laser Scheme -- 4.9 Pumping Three- and Four-Level Lasers -- 4.10 Examples of Three- and Four-Level Lasers -- 4.11 Saturation -- 4.12 Small-Signal Gain and Saturation -- 4.13 Spatial Hole Burning -- 4.14 Spectral Hole Burning -- 4.15 Summary -- Problems -- 5 Laser Oscillation: Power and Frequency -- 5.1 Introduction -- 5.2 Uniform-Field Approximation -- 5.3 Optimal Output Coupling.  
5.4 Effect of Spatial Hole Burning -- 5.5 Large Output Coupling -- 5.6 Measuring Gain and Optimal Output Coupling -- 5.7 Inhomogeneously Broadened Media -- 5.8 Spectral Hole Burning and the Lamb Dip -- 5.9 Frequency Pulling -- 5.10 Obtaining Single-Mode Oscillation -- 5.11 The Laser Linewidth -- 5.12 Polarization and Modulation -- 5.13 Frequency Stabilization -- 5.14 Laser at Threshold -- Appendix: The Fabry-Pérot Etalon -- Problems -- 6 Multimode and Pulsed Lasing -- 6.1 Introduction -- 6.2 Rate Equations for Intensities and Populations -- 6.3 Relaxation Oscillations -- 6.4 Q Switching -- 6.5 Methods of Q Switching -- 6.6 Multimode Laser Oscillation -- 6.7 Phase-Locked Oscillators -- 6.8 Mode Locking -- 6.9 Amplitude-Modulated Mode Locking -- 6.10 Frequency-Modulated Mode Locking -- 6.11 Methods of Mode Locking -- 6.12 Amplification of Short Pulses -- 6.13 Amplified Spontaneous Emission -- 6.14 Ultrashort Light Pulses -- Appendix: Diffraction of Light by Sound -- Problems -- 7 Laser Resonators and Gaussian Beams -- 7.1 Introduction -- 7.2 The Ray Matrix -- 7.3 Resonator Stability -- 7.4 The Paraxial Wave Equation -- 7.5 Gaussian Beams -- 7.6 The ABCD Law for Gaussian Beams -- 7.7 Gaussian Beam Modes -- 7.8 Hermite-Gaussian and Laguerre-Gaussian Beams -- 7.9 Resonators for He-Ne Lasers -- 7.10 Diffraction -- 7.11 Diffraction by an Aperture -- 7.12 Diffraction Theory of Resonators -- 7.13 Beam Quality -- 7.14 Unstable Resonators for High-Power Lasers -- 7.15 Bessel Beams -- Problems -- 8 Propagation of Laser Radiation -- 8.1 Introduction -- 8.2 The Wave Equation for the Electric Field -- 8.3 Group Velocity -- 8.4 Group Velocity Dispersion -- 8.5 Chirping -- 8.6 Propagation Modes in Fibers -- 8.7 Single-Mode Fibers -- 8.8 Birefringence -- 8.9 Rayleigh Scattering -- 8.10 Atmospheric Turbulence -- 8.11 The Coherence Diameter.  
8.12 Beam Wander and Spread -- 8.13 Intensity Scintillations -- 8.14 Remarks -- Problems -- 9 Coherence in Atom-Field Interactions -- 9.1 Introduction -- 9.2 Time-Dependent Schrödinger Equation -- 9.3 Two-State Atoms in Sinusoidal Fields -- 9.4 Density Matrix and Collisional Relaxation -- 9.5 Optical Bloch Equations -- 9.6 Maxwell-Bloch Equations -- 9.7 Semiclassical Laser Theory -- 9.8 Resonant Pulse Propagation -- 9.9 Self-Induced Transparency -- 9.10 Electromagnetically Induced Transparency -- 9.11 Transit-Time Broadening and the Ramsey Effect -- 9.12 Summary -- Problems -- 10 Introduction to Nonlinear Optics -- 10.1 Model for Nonlinear Polarization -- 10.2 Nonlinear Susceptibilities -- 10.3 Self-Focusing -- 10.4 Self-Phase Modulation -- 10.5 Second-Harmonic Generation -- 10.6 Phase Matching -- 10.7 Three-Wave Mixing -- 10.8 Parametric Amplification and Oscillation -- 10.9 Two-Photon Downconversion -- 10.10 Discussion -- Problems -- 11 Some Specific Lasers and Amplifiers -- 11.1 Introduction -- 11.2 Electron-Impact Excitation -- 11.3 Excitation Transfer -- 11.4 He-Ne Lasers -- 11.5 Rate Equation Model of Population Inversion in He-Ne Lasers -- 11.6 Radial Gain Variation in He-Ne Laser Tubes -- 11.7 CO<sub>2</sub> Electric-Discharge Lasers -- 11.8 Gas-Dynamic Lasers -- 11.9 Chemical Lasers -- 11.10 Excimer Lasers -- 11.11 Dye Lasers -- 11.12 Optically Pumped Solid-State Lasers -- 11.13 Ultrashort, Superintense Pulses -- 11.14 Fiber

Amplifiers and Lasers -- 11.15 Remarks -- Appendix: Gain or Absorption Coefficient for Vibrational-Rotational Transitions -- Problems -- 12 Photons -- 12.1 What is a Photon -- 12.2 Photon Polarization: All or Nothing -- 12.3 Failures of Classical Theory -- 12.4 Wave Interference and Photons -- 12.5 Photon Counting -- 12.6 The Poisson Distribution -- 12.7 Photon Detectors -- 12.8 Remarks -- Problems -- 13 Coherence.  
13.1 Introduction -- 13.2 Brightness -- 13.3 The Coherence of Light -- 13.4 The Mutual Coherence Function -- 13.5 Complex Degree Of Coherence -- 13.6 Quasi-Monochromatic Fields and Visibility -- 13.7 Spatial Coherence of Light From Ordinary Sources -- 13.8 Spatial Coherence of Laser Radiation -- 13.9 Diffraction of Laser Radiation -- 13.10 Coherence and the Michelson Interferometer -- 13.11 Temporal Coherence -- 13.12 The Photon Degeneracy Factor -- 13.13 Orders of Coherence -- 13.14 Photon Statistics of Lasers and Thermal Sources -- 13.15 Brown-Twiss Correlations -- Problems -- 14 Some Applications of Lasers -- 14.1 Lidar -- 14.2 Adaptive Optics for Astronomy -- 14.3 Optical Pumping and Spin-Polarized Atoms -- 14.4 Laser Cooling -- 14.5 Trapping Atoms with Lasers and Magnetic Fields -- 14.6 Bose-Einstein Condensation -- 14.7 Applications of Ultrashort Pulses -- 14.8 Lasers in Medicine -- 14.9 Remarks -- Problems -- 15 Diode Lasers and Optical Communications -- 15.1 Introduction -- 15.2 Diode Lasers -- 15.3 Modulation of Diode Lasers -- 15.4 Noise Characteristics of Diode Lasers -- 15.5 Information and Noise -- 15.6 Optical Communications -- Problems -- 16 Numerical Methods for Differential Equations -- 16.A Fortran Program for Ordinary Differential Equations -- 16.B Fortran Program for Plane-Wave Propagation -- 16.C Fortran Program for Paraxial Propagation -- Index.

---

#### Sommario/riassunto

Although the basic principles of lasers have remained unchanged in the past 20 years, there has been a shift in the kinds of lasers generating interest. Providing a comprehensive introduction to the operating principles and applications of lasers, this second edition of the classic book on the subject reveals the latest developments and applications of lasers. Placing more emphasis on applications of lasers and on optical physics, the book's self-contained discussions will appeal to physicists, chemists, optical scientists, engineers, and advanced undergraduate students.

---