HANDBOOK OF LASER TECHNOLOGY & APPLICATIONS

Second Edition

Important Dates

Chapter outline (if requested)	April 2017
Chapter submission	September 30, 2017

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Aims and scope

This comprehensive handbook will offer a completely updated and revised guide to lasers and laser systems, including the full range of their technical applications. The first volume outlines the fundamental components of lasers, their properties and working principles, with brand new chapters in many key areas. The second volume gives encyclopedic coverage of different categories of lasers, from solid-state lasers and semiconductor diode lasers to the latest in fiber, gas, vapor, chemical, and dye lasers. The chapters will provide specifics about the operating characteristics and mechanisms that tailor the laser's performance and beam delivery systems. The third volume covers the broad spectrum of modern applications in all aspects of engineering and technology, including updated case studies in telecommunications, medicine, data storage, spectroscopy, optical measurement, earth sciences, astronomy, plasma research, with new areas such as defense and security, nanomaterials processing and characterization.

Technical level

This handbook is written for the student, scientist, and engineer working with lasers, including those who want to explore the field or some related idea for the first time, and those looking for more detailed discussion on areas of broad interest. It will be useful to anyone engaged in the science, technology, industrial or medical applications of lasers, and those researching the subject as managers or investors in technical enterprises. Chapters should be accessible to science or engineering graduates, requiring no more than standard undergraduate knowledge of optics. The presentation should be concise with informative examples, useful tables, and clear illustrations. Technical terms should be defined upon first use.

Length
Each chapter may consist of approximately 15-20 printed pages (although some may be more or less, depending on subject matter and by arrangement with the editors). Figures may be presented in full-color or greyscale, appropriate to the image. Permission grants are required for previously published materials. See following pages for further information and relevant forms.

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Introduction. *Why is this topic interesting and important? What is its range of impact? This section may incorporate some historical background, if pertinent and illuminating.*

Definitions. *How do you define the scope of this topic, for the purposes of this chapter? It may also be helpful to highlight some key terms with a brief definition.*

Core text. *The main body addresses essential concepts, techniques, processes, phenomena, applications, etc. Use of examples helps the reader grasp the relationship between more abstract information and actual practice.*

Figures and tables. *Inclusion of clear, illustrative photographs, diagrams, graphs, and tables is encouraged. Please note that production requires all figures to be submitted as separate, high-resolution files (eg, Fig01.eps, Fig02.tif, Fig03.pdf, etc)*

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HANDBOOK OF LASER TECHNOLOGY AND APPLICATIONS
2nd Edition

Part A: Laser Components, Properties, and Basic Principles

Section A1: Laser Components

Laser Components: Section Introduction
Gain Media
Pumping Mechanisms
Optical Cavities: Free-Space Laser Resonators
Optical Cavities: Waveguide Laser Resonators
Stable and Unstable Resonators
Laser Beam Control

Section A2: Laser Properties

Properties of Lasers
Monochromaticity
Coherence, Interference, Polarization, and Directionality
High Brightness and Short Pulse

Section A3: Basic Principles

Principles: Section Introduction
Basic Laser Principles
Nonlinear Optics
Optical Waveguide Theory
Optical Detection and Noise
Introduction to Numerical Analysis for Laser Systems

Part B: Laser Design and Fabrication

Section B1: Solid State Lasers

Solid State Lasers: Section Introduction
Transition Metal Ion Lasers: Cr3+
Transition Metal Ion Lasers: Other than Cr3+
Rare Earth Ion Lasers: Nd3+
Titanium Sapphire Lasers
Lanthanide Series Lasers: Near Infrared
Rare-Earth Ions: Ce3+, Tm3+,Er3+, Divalent, Actinides such as U^{3+}, etc.
Host Matrices for Solid State Lasers (thermodynamic and mechanical properties, point groups, crystal structure, optical properties)
Energy Level Diagrams
Hosting Materials (Y3Al5O12, YAlO3, Y3Ga5O12, Y3Fe5O12, YLiF4, Mg2SiO4, CaF2, Al2BeO4, etc)
Dopant Energy Levels in Host Matrices
Lasers Based on Nonlinear Effects
Solid State Raman Lasers
Color Center Lasers

Section B2: Laser Diodes

Laser Diodes: Section Introduction
Basic Principles of Laser Diodes
Spectral Control in Laser Diodes
High-Speed Laser Diodes
High-Power Laser Diodes and Laser Diode Arrays
Visible Laser Diodes: Properties of III–V Red-Emitting Laser Diodes
Visible Laser Diodes: Properties of Blue Laser Diodes
Vertical-Cavity Surface-Emitting Lasers
Long Wavelength Laser Diodes (InGaAs, GaAlAs)
Semiconductor Lasers and Optical Amplifiers for Switching and Signal Processing
Quantum Cascade Lasers
Silicon-Based Lasers

Section B3: Gas/Vapor Lasers

Gas/Vapor Lasers: Section Introduction
Atomic Gas Lasers: Helium–Neon Lasers
Atomic Gas Lasers: Helium–Cadmium Laser
Ion Lasers: Argon Ion Lasers
Ion Lasers: Krypton Ion Lasers
Vapor Lasers: Copper Lasers
Vapor Lasers: Zinc and Gold Vapor Lasers
Molecular Lasers: Carbon Dioxide Lasers
Molecular Lasers: Nitrogen Lasers
Excimer Lasers: Introduction
Excimer Lasers: Construction and Working Principles
Excimer Lasers: Ar2, Kr2, F2, Xe2, ArF, KrF, XeBr, XeCl, XeF, KrCl
Excimer Lasers: KrF, XeCl
Diode-Pumped Alkali Lasers (DPALs)

Section B4: Chemical Lasers

Chemical Lasers: COIL
Chemical Lasers: HF/DF

Section B5: Fiber and Waveguide Lasers

Fiber and Waveguide Lasers: Section Introduction
Fiber Lasers
High Power Fiber Lasers
Cascaded Raman Fiber Lasers
Soliton Lasers
Erbium and Other Doped Fiber Amplifiers
High-Power Waveguide Lasers

Section B6: Dye Laser

Basic Principles of the Dye Laser
Singlet and Triplet States and Intersystem Crossing
Types of Dyes with Their Ranges of Operations and Efficiencies
Solid-State Dye Lasers
Organic Dye Lasers

Section B7: Other Lasers

Other Lasers: Section Introduction
Free Electron Lasers and Synchrotron Light Sources
X-ray Lasers
Liquid Lasers
Quantum Dot Lasers
Optically Pumped Mid-IR Lasers: NH3, C2H2
Far-IR Lasers: HCN, H2O
Terahertz Lasers

Part C: Laser System Design

Section C1: Optical Components

Optical Components: Section Introduction
Optical Components
Optical Control Elements
Adaptive Optics and Phase Conjugate Reflectors
Optomechanical Parts
Power Conditioning: Supplies for Driving Semiconductor Laser Diodes
Power Conditioning: Supplies for Driving Gas Discharges (Gas and Solid State Lasers)
Power Conditioning: Supplies for Driving Flash Tubes and Arclamps for Solid State Lasers

Section C2: Optical Pulse Generation

Optical Pulse Generation: Section Introduction
Quasi-CW and Modulated Beams (Q-swithing & mode locking)
Short Pulses
Ultrashort Pulses
Attosecond Pulse Generation
Pulse Shaping for Stretching and Compression

Section C3: Harmonic Generation

Harmonic Generation: Materials and Methods
Optical Parametric Devices
Laser Stabilization for Precision Measurements
Frequency Conversion and Filtering

Section D3: Nanomaterials Characterizations

Laser Raman Spectroscopy
Laser Scattering Spectroscopy: Rayleigh Scattering, Dynamic Light Scattering
Fast and Ultrafast Spectroscopy for Transient Dynamic Measurements
Nonlinear Optical Characterization of Nanomaterials

Section D4: Optical Metrology

Optical Measurement Techniques: Section Introduction
Fundamental Length Metrology
Laser Velocimetry
Laser Vibrometers
Electronic Speckle Pattern Interferometry (ESPI)
Optical Fiber Hydrophones
Optical Fiber Bragg Grating Sensors for Strain Measurement
High-Speed Imaging
Particle Sizing

Section D5: Biomedical Applications

Medical: Section Introduction
Light–Tissue Interactions
Therapeutic Applications: Introduction
Therapeutic Applications: Ophthalmology
Therapeutic Applications: Refractive Surgery
Therapeutic Applications: Photodynamic Therapy
Therapeutic Applications: Thermal Treatment of Tumors
Therapeutic Applications: Dermatology, Selective Photothermolysis
Therapeutic Applications: Lasers in Vascular Surgery
Therapeutic Applications: Hard Tissue/Dentistry
Therapeutic Applications: Free-Electron Laser
Medical Diagnostics
Laser Applications in Biology and Biotechnology
Biomedical Laser Safety

Section D6: Optical Communications

Communications: Section Introduction
The Basic Point-to-Point Communications System
High-Capacity Optical Transmission Systems
Local Area Networks
Fiber-to-the-Chip: Development of Vertical Cavity Surface Emitting Laser Arrays Designed for Integration with VLSI Circuits
Optical Satellite Communications
Smart Pixel Technologies and Optical Interconnects
Precision Timekeeping: Optical Atomic Clocks
Augmented Reality Devices

Section D7: Optical Information Storage

Optical Information Storage: Section Introduction
Optical Data Storage
Lasers in Printing
3D Printing and Additive Manufacturing

Section D8: Laser Spectroscopy of Atoms, Ions and Molecules

Spectroscopy: Section Introduction
Laser Cooling and Trapping
Ion Trapping and Laser Applications to Length and Time Metrology
Time-Resolved Spectroscopy

Section D9: Lasers in Earth and Environmental Sciences

Earth and Environmental Sciences: Section Introduction
Satellite Laser Ranging
Lidar for Atmospheric Ozone Remote Sensing
Laser-Induced Fluorescence (LIF) Detection of Vegetation and Microbes

Section D10: Lasers in Astronomy

Lasers in Astronomy: Section Introduction
Lasers in Astronomy

Section D11: Holography

Holography: Holographic Optical Elements and Computer-Generated Holography
Holography: Holographic Optical Elements—Diffractive Optics

Section D12: Lasers in Plasma Research

High-Intensity Lasers for Plasma Studies: Section Introduction
High-Power Lasers for Plasma Physics
High-Power Lasers and the Extreme Conditions They Produce

Section D13: Lasers for Defense and Security

Lasers for Defense and Security: Section Introduction
High-Energy Lasers for Defense
Laser Sensors for Security and Surveillance
Laser-Guided Missiles and Laser Guns

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  1.1 First Level Heading
  1.1.1 Second Level Heading
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· In-text: (Wiens 1983)

Journal article
Terborgh, J. 1974. Preservation of natural diversity. *BioScience* 24: 715-22.
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VI. Submission to the book editor

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Chapter title
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Visio *save as* **.pdf** –
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