APPENDIX A

GOOD BOOKS

If you're going to build electro-optical systems for a living, you're going to have to change fields a lot. If you're still in school, use the opportunity to broaden your expertise—an optics or experimental physics student should learn signal processing and circuit design, and an electrical engineering student, classical and quantum mechanics. It's well worth devoting an extra semester to, if you can afford it—graduate students usually can. The rest of us need good readable books that don't demand total devotion.

The present author's usual way to start learning a new field is to get a good undergraduate-level textbook and read it like a novel. Pay special attention to getting the very basic concepts down perfectly; as we've seen in earlier chapters, our confidence in working in a new area depends entirely on how sure we are of our tools. For example, Fourier optics is an approximation, but the Fourier decomposition of an optical field is exact; in electronics, metal resistors are linear and have only Johnson noise, and capacitors subtract DC noiselessly. In this class also are the classical techniques of other fields. For instance, the use of UHF modulation to suppress mode hopping in diode lasers is an idea first used around 1930, in the quench circuits of superregenerative receivers. (Superregeneration is an amazingly cute idea—you can amplify the Johnson noise enough to drive headphones with a single low-gain stage; see Terman, *Radio Engineering*.) Thanks are due to the assembled expertise of the Usenet groups sci.optics, alt.lasers, and sci.electronics.design for suggestions and criticism. Those are also excellent places to find electro-optical design help. One thing to remember about Usenet technical groups: the crisper the question, the more helpful the answer, in general.

Building Electro-Optical Systems, Second Edition. By Philip C. D. Hobbs
ISBN 0-471-24681-6

Legend:

⚒	Introductory level: Accessible to technical people from outside the field
⚒⚒	Intermediate: Advanced undergraduate level, some background required
⚒⚒⚒	Advanced: university-level preparation required.
🚫	Available free online

MATHEMATICS

George B. Arfken and Hans-Jurgen Weber, *Mathematical Methods for Physicists*, Fourth edition, Academic, 1995. Good standard undergraduate text on classical analysis, with the usual physicist's mathematical permissiveness; especially good on complex variables. ⚒

Carl M. Bender and Steven A. Orszag, *Advanced Mathematical Methods for Scientists and Engineers: Asymptotic Methods and Perturbation Theory*, Springer, 1999, (Reprint of the 1978 edition). The best applied math book of all time: light on the rigour, but powerful and full of physical insight (and good graphs). Excellent problems. ⚒⚒

Ronald N. Bracewell, *The Fourier Transform and Its Applications*, Third edition, McGraw-Hill, 1999. Bracewell teaches you how to think in Fourier space, which is hugely valuable for optics and electronics folk. ⚒

I. M. Gelfand and S. V. Fomin, *Calculus of Variations*, Richard A. Silverman, translator, Prentice-Hall, 1963. Variational methods are a uniquely powerful way to get solutions to a lot of problems in electromagnetics and mechanics, which lead straight to useful algorithms. Short, accessible and has all the variational horsepower you're likely to need. ⚒⚒

Roger A. Horn and Charles R. Johnson, *Matrix Analysis*, Cambridge University Press, 1987. Covers advanced linear algebra topics, such as singular value decomposition, condition numbers, and so on. It's a math book, all right, but it's nice and clear, and states results in algorithmically useful forms. ⚒⚒

Athanasius Papoulis, *Probability, Statistics, and Stochastic Processes*, Third edition, McGraw-Hill, 1991. Readable and full of useful examples in statistical signal processing, *e.g.* Wiener and Kalman filters, maximum entropy estimation, maximum likelihood tests, Monte Carlo methods, and detection of signals in noise. ⚒⚒

MATHEMATICAL TABLES

Milton Abramowitz and Irene A. Stegun, *Handbook of Mathematical Functions with Formulas, Graphs, and Mathematical Tables*, US National Bureau of Standards, 1964. All about practical uses of special functions. Contains low and high accuracy tables, integral representations, asymptotic forms, and polynomial approximations. ⚒🚫

Izrail S. Gradshteyn and Iosif M. Ryzhik, *Tables of Integrals, Series, and Products*, Fourth edition, Academic Press, 1994, Corrected reprint of the 1980 edition. A gigantic, well organized, and highly accurate set of integral tables. ⚒⚒

Daniel Zwillinger, *CRC Standard Mathematical Tables and Formulae*, 30^{th} edition, Chemical Rubber Company, 1996. Smaller and more accessible than G&R, this one has trigonometric and combinatoric identities and a much smaller table of integrals. 🛠

ELECTROMAGNETICS

Roger F. Harrington, *Time Harmonic Electromagnetic Fields*, Second edition, IEEE, 1996 (Reprint of the 1961 edition). Especially good on variational principles and the radiation reaction concept—powerful but less widely known tools for EM problems. 🛠🛠🛠

Roger F. Harrington, *Field Computation by Moment Methods*, Second edition, IEEE, 1993 (reprint of 1968 MacMillan edition). The method of moments is the standard way to solve complicated antenna and metal waveguide problems. This book gives a unified and easy-to-follow development. 🛠🛠🚫

John D. Jackson, *Classical Electrodynamics*, Third Edition, Wiley, 1998 An excellent upper-level electromagnetics text, with particularly good chapter problems. 🛠🛠

Lev D. Landau, Evgeny M. Lifshitz, and Lev P. Pitaevskii, *Electrodynamics of Continuous Media*, Pergamon, 1984. Gives another angle on electromagnetics. L&L is especially good on crystal optics. 🛠🛠

Simon Ramo, John R. Whinnery, and Theodore Van Duzer, *Fields and Waves in Communication Electronics*, Third edition, Wiley, 1994. An advanced E&M text with unusual coverage that's often very helpful; things like conservation of complex power, calculating inductance and capacitance, antennas, transmission lines and resonators. 🛠🛠

Albert Shadowitz, *The Electromagnetic Field*, Dover, 1988. A 'div, grad, curl' E&M textbook with an engineering angle and lots of very clear explanations, at an introductory level (Maxwell's equations don't show up till Chapter 11). Inexpensive. 🛠

Allen Taflove and Susan C. Hagness, *Computational Electrodynamics: The Finite Difference Time Domain Method*, Third edition, Artech House, 2005. A big book on the state of the FDTD art, with lots of details; explicit equations and algorithms you can code. 🛠🛠

OPTICS

Nicolaas Bloembergen, *Nonlinear Optics*, Fourth edition, World Scientific, 1996, (Reprint of 1965 edition with updated references.) The best books are usually written by the pioneers, and Bloembergen is an excellent example: clearly written and physically lucid. 🛠🛠🛠

Max Born and Emil Wolf, *Principles of Optics*, Sixth edition, Cambridge University Press, reissued 1998. The standard work on optical theory: propagation, diffraction, coherence, aberrations, you name it. 🛠🛠

V. A. Borovikov and B. Ye. Kinber, *Geometrical Theory of Diffraction*, IEEE, 1994. If you have to do GTD for real, this is the book. Not elementary, but clear and complete. 🛠🛠🛠

Robert F. Fischer, *Optical Systems Design*, Second edition, McGraw-Hill, 2007. More centred on lenses than Smith. Has a lot of hands-on stuff, from design to glass selection to tolerancing, and a great list of bloopers at the end. 🛠

Grant R. Fowles, *Introduction to Modern Optics*, Second Edition, Dover, 1989. Fowles provides a lot of good physical insight into optical phenomena. Inexpensive. 🛠

Jack D. Gaskill, *Linear Systems, Fourier Transforms, and Optics*, Publisher: Wiley-Interscience, 1978. Develops the whole theory of 1- and 2-D linear systems from scratch, then derives Fourier optics and CTF/OTF as consequences. More mathematical than some. 🛠🛠

A. Gerrard and J. M. Burch, *Introduction To Matrix Methods In Optics*, Dover, 1994. Presents the mathematics of ABCD, Gaussian beam, and polarization matrix calculations in a clear and comprehensive way; Inexpensive. 🛠

Joseph W. Goodman, *Introduction to Fourier Optics*, Second edition, McGraw-Hill, 1986. A well-written brief introduction, whose elementary level limits it to the paraxial case. 🛠

Joseph W. Goodman, *Statistical Optics*, Wiley-Interscience, 1985. Very readable and complete: covers speckle, classical and quantum fluctuations, and the complete theory of imaging with partially coherent light, using fairly advanced statistical reasoning. 🛠🛠🛠

Eugene Hecht, *Optics*, Addison-Wesley, Fourth edition, 2002. An introductory optics text, with lots of physical insight. Especially good on Fourier and physical optics. 🛠

Kenji Kawano and Tsutomu Kitoh, *Introduction to Optical Waveguide Analysis*, Wiley, 2001. All about numerically calculating modes and propagation in optical waveguides and fibres. Lots of details. 🛠🛠🛠

Rudolf Kingslake, *Lens Design Fundamentals*, Academic Press, 1978, and *Optical Systems Design*, Academic Press, 1983. These books are classics, reflecting the Conrady tradition of hand calculation in optical design. You can't run a numerical optimizer with a desk calculator, so Kingslake talks a lot about heuristics and intuitive methods, and this alone is worth the price of the books. 🛠🛠

Miles V. Klein and Thomas E. Furtak, *Optics*, Second edition, Wiley, 1986, Compared with Hecht, K&F has much more on geometric optics and aberration and less on physical optics. Some mathematical errors. 🛠

Virendra N. Mahajan, *Aberration Theory Made Simple*, SPIE, 1991. An accessible but oddly split treatment of wave and ray aberrations. A bit weaker on the connections and disconnects between them, *e.g.* the subtle changes in terminology. 🛠

Bahaa E. A. Saleh and Melvin C. Teich, *Fundamentals of Photonics*, Second Edition, Wiley, 2007. Starts from the basics and covers most devices of interest. 🛠

Warren Smith, *Modern Optical Engineering*, McGraw-Hill, Fourth edition, 2007. Good self-teaching book on all aspects of classical optics—rays, aberrations, diffraction, lens design, combining stock lenses. Accessible but not at all simplistic. 🛠

J. J. Stamnes, *Waves in Focal Regions*, Adam Hilger, 1986. A very complete treatment of wave propagation in all cases where diffraction is important: especially good on the fine points of the plane wave spectrum. ⚒⚒

Pyotr Ya. Ufimtsev, *Elements of the Physical Theory of Diffraction*, Wiley, 2007. Ufimtsev's theory is the foundation of stealth technology—PTD is GTD taken one perturbation order further. (An old version is available at http://www.dtic.mil.) ⚒⚒⚒🚫

US Department of Defense, *Optical Design: Military Standardization Handbook 141 (MIL-HDBK-141)*, US Defense Supply Agency, 1962, Everything from optical glass to atmospheric optics and lens testing. Still remarkably current.
http://www.optics.arizona.edu/optomech/references/Mil-hdbk-141.mht. ⚒🚫

OTHER PHYSICS

Lev D. Landau, Evgeny M. Lifshitz, and Lev P. Pitaevskii, *Statistical Physics* Third edition, (2 vols), Pergamon, 1980. Especially good on black body radiation and the fluctuation-dissipation theorem, from a theoretical physics point of view. ⚒⚒

Simon M. Sze, *Physics of Semiconductor Devices*, Second Edition, Wiley, 1981 (The third edition (2006), isn't as good on the basics.) Gives detailed explanations of how semiconductor devices work; enough equations but few derivations. ⚒⚒

CIRCUITS

American Radio Relay League, *The Radio Amateur's Handbook*, ARRL, Annual. Covers modulation, signal processing, and wave propagation with lots of lore and heuristic arguments: accessible, not rigorous. Pre-1990 editions had lots of RF construction lore. ⚒

Harold S. Black, *Modulation Theory*, Van Nostrand, 1953. Lots of detail on AM, FM, time and frequency division multiplexing, Shannon's theorem and entropy in modulation schemes, in a clear style, by the inventor of negative feedback. ⚒⚒

Hendrik W. Bode, *Network Analysis and Feedback Amplifier Design*, Van Nostrand, 1945. Bode more or less invented network analysis, and the combination of clear explanation and conceptual rigour is unbeatable. Especially good on matching network design. ⚒⚒

Hans Camenzind, *Designing Analog Chips*, http://www.designinganalogchips.com. By the designer of the 555 timer chip; an interesting read with a lot of good background on devices and simulation. ⚒🚫

Ralph S. Carson, *High Frequency Amplifiers*, Wiley, 1982. A lucid explanation of S-parameter design of high frequency amplifiers, based on Smith charts. This is how you really do it. ⚒⚒

Jiri Dostal, *Operational Amplifiers*, Second edition, Butterworth-Heinemann, 1997. Combines arm waving and rigorous mathematical treatment of high performance op amp circuits. Very readable and full of insight, and covers every op amp problem imaginable. Out of print; soft copies are available at various places on the web but may be bootlegs. ⚒⚒🚫

Floyd M Gardner, *Phaselock Techniques*, Third edition, Wiley, 2005. All about analogue phase-locked loops, including frequency synthesis, PLL signal detection, telemetry, and Doppler tracking. Just the right amount of math so you can do it yourself. 🛠

Paul A. Gray and Robert G. Meyer, *Analysis and Design of Analog Integrated Circuits*, Second edition, Wiley, 1984. Lots of insight into BJT, FET, and IC performance and behaviour. If you don't know how a transistor works, this is your book. 🛠🛠

Paul Horowitz and Winfield Hill, *The Art of Electronics*, Second edition, Cambridge University Press, 1989. Indispensable if you design circuits, even if it's just the occasional op amp. A third edition is due in 2009. 🛠

Donald E. Lancaster, *Active Filter Cookbook*, Second Edition, Newnes, 1996. Only slightly changed from the 1975 edition, but still very useful when you need to hack together a low-frequency filter. 🛠

Robert A. Pease, *Troubleshooting Analog Circuits*, Butterworth-Heinemann, 1991. An entertaining and readable look at troubleshooting. Full of war stories, and applicable to a lot of other types of systems besides analogue circuits. 🛠

Frederick E. Terman, *Radio Engineering*, Third edition, McGraw-Hill, 1947. A big, very good book on all aspects of analogue signal processing and network design. 🛠🛠

Frederick E. Terman, *Radio Engineer's Handbook*, McGraw-Hill, 1943. Full of old-but-useful tables, curves, and classical techniques for when the derivative modern treatments don't have enough detail. 🛠🛠

Mac E. Van Valkenburg, *Reference Data For Engineers*, Eighth edition, Howard W. Sams, 1995. Lots of practical stuff about design of RF, communications, analogue and digital circuits. This edition branches out from the previous radio-only focus, but still has a lot of great RF stuff. 🛠

Arthur Williams and Fred J. Taylor, *Electronic Filter Handbook*, Fourth Edition, McGraw-Hill, 2006. Perfect for people who occasionally need to design a custom active or LC filter but don't care about the math. Previous editions were better printed. 🛠

Jim Williams, editor. *Analog Circuit Design: Art, Science, and Personalities*, Butterworth-Heinemann, 1991, and *The Art and Science of Analog Circuit Design*, Butterworth-Heinemann, 1995. The lore of analogue design, told in a playful and sometimes whimsical style by masters of the art. The second book is especially good on high-impedance, high frequency circuits–very useful in front end design. 🛠

Anatol Zverev, *Handbook of Filter Synthesis*, Wiley, 1967. A big book of passive LC filter design tables and plots. Has unique designs, *e.g.* the equiripple group delay filter. 🛠🛠

NOISE AND INTERFERENCE

Aldert van der Ziel, *Noise in Solid State Devices and Circuits*, Wiley, 1986. A brief, accessible, but complete introduction to noise in semiconductors and circuits, which is a surprisingly pretty subject. 🛠🛠

Ralph Morrison, *Grounding and Shielding Techniques*, Fourth edition, Wiley, 1998. Morrison gives the physical causes of interference and spurious radiation, then shows how to get rid of it. 🛠

Henry W. Ott, *Noise Reduction Techniques In Electronic Systems*, Second edition, Wiley, 1988. Solid on grounding, shielding, decoupling, filtering, and how to calculate noise and interference. Essential for low noise circuit designers. 🛠

T. H. Wilmshurst, *Signal Recovery From Noise In Electronic Instrumentation*, Second edition, Adam Hilger, 1991. The gory details of lock-in detection, signal averaging, and so forth. 🛠

OPTOMECHANICS

Eugene A. Avallone and Theodore Baumeister III, *Marks' Standard Handbook for Mechanical Engineers*, 10^{th} edition, McGraw-Hill, 1996. Covers a wide field, even incineration and power generation, but the depth of detail and choice of material is excellent. 🛠🛠

Erik V. Oberg and Christopher J. McCauley, *Machinery's Handbook*, 25^{th} edition, Industrial Press, 1996. Full of good stuff about machine shop practice. 🛠

Stephen P. Timoshenko, *Theory of Plates and Shells*, Second edition, McGraw-Hill, 1959, (Recently reprinted). A wonderful mixture of explanation and cookbook formulas on deflection, resonance, buckling, and deformation of structures, especially those that have to be stiff and light. 🛠🛠

Paul R. Yoder, *Opto-mechanical Systems Design*, Third edition, CRC Press, 2005. Covers the mechanical design of optical instruments, test jigs, and so on. Yoder has immense design experience, and the book repays close attention. 🛠🛠

DETECTION AND FRONT ENDS

Stephen B. Alexander, *Optical Communications Receiver Design*, Institution of Electrical Engineers, 1997. A good book on how to detect optical signals in the presence of noise, with attention to various modulation schemes. 🛠🛠

Eustace L. Dereniak and Glenn D. Boreman, *Infrared Detectors and Systems*, Wiley, 1996. Has a good discussion of most modern IR detectors, plus sections on noise, MTF, statistics, and general photodetector operation. 🛠🛠

Silvano Donati, *Photodetectors: Devices, Circuits, and Applications*, Prentice-Hall, 1999. A clear prsentation of the physics and circuit characteristics of photodetectors. 🛠🛠

Hamamatsu Photonics, *Photomultiplier Tubes: Basics and Applications*, Third Edition. Not just product information, but how PMTs work and lots of good lore on the ins and outs of making good PMT measurements. 🛠

James R. Janesick, *Scientific Charge-Coupled Devices*, SPIE Press, 2001. A big book full of CCD basics and arcana: sometimes verbose but very complete. 🛠

Mark Johnson, *Photodetection and Measurement: Maximizing Performance in Optical Systems*, McGraw-Hill, 2003. How to make optical measurements, starting from simple concepts and progressing to the whole system. Especially good hands-on sections. 🛠

MEASUREMENTS AND SYSTEMS

Brian Culshaw and John Dakin, eds. *Optical Fiber Sensors Volume 3: Components and Subsystems*, Artech, 1996. A survey of fibre sensors and some of the underlying technology. Uneven in quality but good on fibre gratings and spectral measurements. 🛠

Robert Hanbury Brown, *The Intensity Interferometer: Its Application to Astronomy*, Halsted Press (Wiley), 1974. An epic technical war story of getting a completely novel type of telescope built, and its unique contributions. 🛠

Richard D. Hudson, *Infrared Systems Engineering*, Wiley, 2006, (Reprint of the 1969 edition). The essential problems of infrared systems don't change much with time, and Hudson remains the best guide to IR system design. 🛠🛠

Albert V. Jelalian, *Laser Radar Systems*, Artech House, 1992. Everything about detecting objects by bouncing laser beams off them. Jelalian is readable and clear. 🛠🛠

David S. Kliger, *Ultrasensitive Laser Spectroscopy*, Academic Press, 1983. Now somewhat dated, but still very good on the techniques and difficulties of ultrasensitive optical measurements. Engaging and full of lore. 🛠🛠

Marc D. Levenson and Satoru S. Kano, *Introduction to Nonlinear Laser Spectroscopy*, Revised edition, Academic Press, 1988. Good for coming up to speed in laser spectroscopy quickly; includes chapter problems and lab exercises. 🛠🛠

Merrill I. Skolnik, *Radar Handbook*, Second edition, McGraw-Hill, 1990. More advanced signal processing and the problems and tradeoffs of instrument design. Applicable far beyond radar. 🛠

Eric Udd, *Fiber Optic Sensors: An introduction for Engineers and Scientists*, Wiley-Interscience, 1991. A bit long in the tooth now, but contains a fair amount of lore from experts. Non-fibre alternatives are not really given their due. 🛠🛠

CONSTRUCTION

Daniel Malacara, ed. *Optical Shop Testing*, Third Edition, Wiley, 2007. Covers all kinds of interferometric testing, as well as screen (Ronchi and Hartmann), star, profilometer, and other tests for optical surfaces. If it isn't here, you probably can't test it. 🛠🛠🛠

John H. Moore, Christopher C. Davis, and Michael A. Coplan, *Building Scientific Apparatus*, Second Edition, Addison-Wesley, 1989. A very readable guide to building apparatus, with lots of stuff about basic optics, mechanics, vacuum, and electronics. 🛠

John Strong, *Procedures in Experimental Physics*, Lindsay Publications, 1986 (Reprint of 1938 edition.) A great hands-on book on glasswork, moulding, vacuum, and so on. 🛠

LASERS

Samuel M. Goldwasser, *Sam's Laser FAQ*, http://www.repairfaq.org/sam/lasersam.htm. Everything about lasers, from basic physics to connector pinouts. A labour of love drawing on decades of nitty-gritty experience.

Walter Koechner, *Solid State Laser Engineering*, Sixth edition, Springer, 2006. The standard work on building solid state lasers—theory, materials, pumping and thermal strategy, Q-switching, mode locking, and nonlinear elements.

Motoichi Ohtsu, *Highly Coherent Semiconductor Lasers*, Artech House, 1991, and *Frequency Control of Semiconductor Lasers*, Wiley, 1996. Design and experimental data on how to stabilize diode lasers, for spectroscopy, frequency standards, and other uses.

Anthony E. Siegman, *Lasers*, University Science Books, 1986. Covers all aspects of lasers at a first year graduate level; accessible and full of good intuitive examples. Due to its age, better on gas and solid state lasers than diodes.

DIGITAL SIGNAL PROCESSING AND NUMERICAL ANALYSIS

Forman Acton, *Numerical Methods That Work*, Mathematical Association of America, 1990, (Reprint of 1970 Harper & Row edition) Salty, opinionated, and very lucid; full of lore, including a lovely section on what *not* to compute.

E. Oran Brigham, *The Fast Fourier Transform*, Prentice-Hall, 1974. The ins and outs of FFT algorithms. Readable and very worthwhile if you write any signal processing code.

Philip J. Davis and Philip Rabinowitz, *Methods of Numerical Integration*, Academic Press, 1975. Covers all sorts of numerical integration, by way of hundreds of short discussions of the algorithmic ingenuity of each approach, which sheds a lot of light on numerical mathematics generally.

Dennis C. Ghiglia and Mark D. Pritt, *Two Dimensional Phase Unwrapping*, Wiley, 1998. 2-D unwrapping is a ubiquitous and very thorny problem; G&P gives the gory details for times when the seat-of-the-pants approach fails.

Richard W. Hamming, *Digital Filters*, Third edition, Dover, 1997, (Reprint of Prentice Hall 1989 edition). Covers nonrecursive digital filters from an intuitive point of view; good for coming up to speed rapidly. Inexpensive.

J. F. Hart *et al. Computer Approximations*, R. E. Krieger, 1978, (Reprint of 1968 Wiley edition). Computer-generated rational function approximations to special functions.

Alan V. Oppenheim and Ronald W. Shafer, *Digital Signal Processing*, Prentice-Hall, 1975. Old but good; fairly heavily theoretical.

William H. Press, Brian P. Flannery, Saul A. Teukolsky, and Steven Vetterling, *Numerical Recipes in C*, Second Edition, Cambridge University Press, 1992. A pretty good numerical

analysis book that comes with a lot of working code you can use right away. There's a third (C++) edition, but the second (C) edition is available free, and the C routines may be easier to integrate with your code.

L. R. Rabiner and B. Gold, *Theory and Application of Digital Signal Processing*, Prentice-Hall, 1974. The applied follow-on to Oppenheim and Shafer. Not so mathematical, and with a fair amount of lore and good insights on when to use the different algorithms.

Anthony Ralston and Philip Rabinowitz, *A First Course in Numerical Analysis*, Second edition, McGraw-Hill, 1978. An undergraduate text with lots of examples, good for self-teaching. R&R have no patience with 'neat but useless' techniques.

Steven W. Smith, *The Scientist and Engineer's Guide to Digital Signal Processing*. An elementary DSP book with a wide coverage, lots of pictures and discussion, cookbook tables, and very little math. Excellent for getting your feet wet. http://www.dspguide.com.

HANDBOOKS WORTH HAVING

J. S. Accetta and David L. Shumaker, *The Infrared and Electro-Optical Systems Handbook* (8 volumes), Infrared Information, 1993, also available for download from http://www.dtic.mil. All kinds of tables and discussion—not as handbooky as most others.

C. W. Allen, *Astrophysical Quantities*, Third edition, Athlone, 1985. Where else can you find out that the night sky has $\sim$0.1 naked-eye visible stars per square degree?

Michael Bass *et al.*, editors, *Handbook of Optics* (4 volumes), Optical Society of America and McGraw-Hill, 1995–2000. Volume I: Fundamentals, Techniques, and Design; Volume II Devices, Measurements, and Properties; Volume III: Classical, Vision, and X-Ray Optics; and Volume IV: Fiber Optics and Nonlinear Optics. Truly gigantic—not the last word on any optical subject, but a good place to start for most.

Burle Industries (formerly RCA), *Electro-Optics Handbook*, 1974. The 'RCA handbook' that started it all. Still very very useful, and free.

Chemical Rubber Company, *CRC Handbook of Chemistry and Physics*, CRC Press, Annual. A huge book full of tables, indispensable for mixed-technology systems like EO systems: the 'rubber bible' has lots about materials, including enough optical properties that you may not need Palik & Ghosh. Recent editions are *much* better than the old ones.

G. W. C. Kaye and T. H. Laby, *Handbook of Physical and Chemical Constants and Some Mathematical Functions*, 15^th edition, Longman, 1986. A real instrument-builder's handbook, very useful when you have to choose materials, or calculate heat transfer–it has obscure things like the specific heat and thermal conductivity of tantalum wire.

Edward D. Palik and Gorachand Ghosh, *Handbook of Optical Constants of Solids*, Second edition (4 volumes) Academic, 1997. Very expensive but sometimes invaluable. Lots of detailed critiques of how the constants were measured.

William L. Wolfe and George J. Zissis, *The Infrared Handbook*, Revised edition, ERIM, 1985. Lots of good tables and curves make this a useful handbook for designers.