

References and Editorial Standards

The complete reference library — courses, devices, BMEssentials, and BMEssence guides

The published canon behind every course, device, lecture, and guide on BMEssentia

Every course, device, lecture, and guide on BMEssentia is anchored in the published canon of biomedical engineering: the field's standard textbooks, international standards, landmark primary literature, and current peer-reviewed reviews. Practice questions are derived from the sources listed for their parent course or device. All 3,800+ illustrations are original works created by BMEssentia; each illustration's accompanying description is anchored in the reference sources of its parent course or device. Course scope is aligned with ABET biomedical engineering program criteria and IFMBE curriculum guidance. All references are English-language publications. References are reviewed annually.

HOW THIS LIBRARY IS STRUCTURED

- Courses: each course carries Core Texts, Standards and Regulatory sources, Landmark Papers, Current Reviews, and a Chapter Anchoring section tracing every chapter to its sources.
- Devices: each of the 69 devices carries a self-contained reference list built to one standard: canonical texts, the device's own particular standard, IEC 62353 for every powered device, a quality-control source, a clinical-use source, a systems and economics source where the device warrants it, and a recent (2015-2025) anchor.
- BMEssentials: the protocols are original works of the founder. Each of the four phases carries its scientific foundation, and each of the 31 lectures carries the studies it operationalizes.
- BMEssence guides: each of the five series carries a full series-level foundation. Device-based series additionally inherit the reference block of their device; the Cognitive Intelligence series inherits its lecture blocks.
- Every block carries its review date and next scheduled review.

CONTENTS

- Part 1: Courses (22)
- Part 2: Device Library (69 devices)
- Part 3: Expand Your Expertise courses
- Part 4: BMEssentials — phases and lectures
- Part 5: BMEssence guide series
- Editorial Standards

Part 1: Courses

Course 1: The Biomedical Engineering Blueprint

CORE TEXTS

- Enderle, J., Bronzino, J., Introduction to Biomedical Engineering, Elsevier
- Saltzman, W. M., Biomedical Engineering: Bridging Medicine and Technology, Cambridge University Press
- Bronzino, J. D. (ed.), The Biomedical Engineering Handbook, CRC Press
- Hobbie, R. K., Roth, B. J., Intermediate Physics for Medicine and Biology, Springer
- Herman, I. P., Physics of the Human Body, Springer
- Webster, J. G. (ed.), Medical Instrumentation: Application and Design, Wiley
- Carr, J. J., Brown, J. M., Introduction to Biomedical Equipment Technology, Pearson
- Khandpur, R. S., Handbook of Biomedical Instrumentation, McGraw Hill
- Hall, J. E., Guyton and Hall Textbook of Medical Physiology, Elsevier
- Silverthorn, D. U., Human Physiology: An Integrated Approach, Pearson
- Alberts, B., et al., Essential Cell Biology, W. W. Norton
- Urry, L. A., et al., Campbell Biology, Pearson
- Özkaya, N., et al., Fundamentals of Biomechanics, Springer
- Nordin, M., Frankel, V. H., Basic Biomechanics of the Musculoskeletal System, Wolters Kluwer
- Horowitz, P., Hill, W., The Art of Electronics, Cambridge University Press
- Plonsey, R., Barr, R. C., Bioelectricity: A Quantitative Approach, Springer
- Rangayyan, R. M., Biomedical Signal Analysis, Wiley-IEEE Press
- Sörnmo, L., Laguna, P., Bioelectrical Signal Processing in Cardiac and Neurological Applications, Elsevier
- Wang, L. V., Wu, H., Biomedical Optics: Principles and Imaging, Wiley
- Vo-Dinh, T. (ed.), Biomedical Photonics Handbook, CRC Press
- Bushberg, J. T., et al., The Essential Physics of Medical Imaging, Wolters Kluwer
- Smith, N. B., Webb, A., Introduction to Medical Imaging, Cambridge University Press
- Beauchamp, T. L., Childress, J. F., Principles of Biomedical Ethics, Oxford University Press
- Iadanza, E. (ed.), Clinical Engineering Handbook, Elsevier

STANDARDS AND REGULATORY

- IEC 60601-1, Medical Electrical Equipment: General Requirements for Basic Safety and Essential Performance
- IEC 62353, Recurrent Test and Test After Repair of Medical Electrical Equipment
- World Medical Association, Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects
- The Belmont Report, U.S. National Commission for the Protection of Human Subjects, 1979
- ABET, Criteria for Accrediting Engineering Programs
- IFMBE, field and curriculum resources

LANDMARK PAPERS

- Hodgkin, A. L., Huxley, A. F., "A quantitative description of membrane current and its application to conduction and excitation in nerve," Journal of Physiology, 1952
- Clark, L. C., Lyons, C., "Electrode systems for continuous monitoring in cardiovascular surgery," Annals of the New York Academy of Sciences, 1962
- Huang, D., et al., "Optical coherence tomography," Science, 1991
- Lauterbur, P. C., "Image formation by induced local interactions," Nature, 1973
- National Academy of Engineering, Grand Challenges for Engineering
- Nebeker, F., "Golden accomplishments in biomedical engineering," IEEE Engineering in Medicine and Biology Magazine, 2002

CURRENT REVIEWS

- Turner, A. P. F., "Biosensors: sense and sensibility," Chemical Society Reviews, 2013
- Wang, B., et al., WHO Medical Devices Technical Series, Human Resources for Medical Devices: The Role of Biomedical Engineers, 2017
- Madhavan, G., Oakley, B., Kun, L. (eds.), Career Development in Bioengineering and Biotechnology, Springer

CHAPTER ANCHORING

- Introduction to Biomedical Engineering: Enderle and Bronzino; Saltzman; NAE Grand Challenges; Nebeker
- Biomedical Equipment Technology: Carr and Brown; Khandpur; IEC 60601-1
- Fundamentals of Physics in Biomedical Engineering: Hobbie and Roth; Herman
- Fundamentals of Mechanics in Biomedical Engineering: Özkaya; Nordin and Frankel
- Fundamentals of Biology in Biomedical Engineering: Campbell Biology; Alberts, Essential Cell Biology
- Fundamentals of Human Physiology: Guyton and Hall; Silverthorn
- Electrical Fundamentals of Biomedical Engineering: Horowitz and Hill; Plonsey and Barr
- Biomedical Ethics: Beauchamp and Childress; Declaration of Helsinki; Belmont Report
- Biological Signals: Rangayyan; Sörnmo and Laguna
- Bioinstrumentation: Webster
- Biosensors: Clark and Lyons; Turner; Webster
- Biomedical Optics: Wang and Wu; Vo-Dinh; Huang et al.
- Principles of Medical Imaging: Bushberg; Smith and Webb; Lauterbur
- Clinical Engineering: Iadanza; IEC 62353; WHO 2017

References reviewed: August 2026. Next review: August 2027.

Course 2: Human Anatomy

CORE TEXTS

- Tortora, G. J., Derrickson, B., Principles of Anatomy and Physiology, Wiley
- OpenStax, Anatomy and Physiology 2e, Rice University
- Standring, S. (ed.), Gray's Anatomy: The Anatomical Basis of Clinical Practice, Elsevier

- Drake, R., Vogl, A. W., Mitchell, A., Gray's Anatomy for Students, Elsevier
- Moore, K. L., Dalley, A. F., Agur, A. M. R., Clinically Oriented Anatomy, Wolters Kluwer
- Netter, F. H., Atlas of Human Anatomy, Elsevier
- Marieb, E. N., Hoehn, K., Human Anatomy and Physiology, Pearson

STANDARDS AND REGULATORY

- FIPAT, Terminologia Anatomica

LANDMARK PAPERS

- Spitzer, V., Ackerman, M. J., Scherzinger, A. L., Whitlock, D., "The Visible Human Male: a technical report," Journal of the American Medical Informatics Association, 1996
- Ackerman, M. J., "The Visible Human Project," Proceedings of the IEEE, 1998

CURRENT REVIEWS

- Sugand, K., Abrahams, P., Khurana, A., "The anatomy of anatomy: a review of education," Anatomical Sciences Education, 2010
- Estai, M., Bunt, S., "Best teaching practices in anatomy education: a critical review," Annals of Anatomy, 2016
- Yammine, K., Violato, C., "A meta-analysis of the educational effectiveness of three-dimensional visualization technologies in teaching anatomy," Anatomical Sciences Education, 2015
- StatPearls, NCBI Bookshelf, anatomy entries, National Library of Medicine (open access)

CHAPTER ANCHORING

- Introduction to Human Anatomy: Tortora ch. 1; OpenStax unit 1; Terminologia Anatomica for all nomenclature
- The Skeletal System: Tortora and OpenStax skeletal chapters; Gray's for osteology depth; Netter plates
- The Muscular System: Tortora and OpenStax muscular chapters; Moore for functional muscle anatomy; Netter plates
- The Nervous System: Tortora and OpenStax nervous system chapters; Gray's neuroanatomy sections
- The Cardiovascular System: Tortora and OpenStax cardiovascular chapters; Gray's for heart and vasculature; Netter plates
- The Respiratory System: Tortora and OpenStax respiratory chapters; Moore thorax
- The Digestive System: Tortora and OpenStax digestive chapters; Moore abdomen
- The Urinary System: Tortora and OpenStax urinary chapters; Gray's for renal anatomy
- The Endocrine System: Tortora and OpenStax endocrine chapters
- The Reproductive System: Tortora and OpenStax reproductive chapters; Moore pelvis and perineum
- The Integumentary System: Tortora and OpenStax integument chapters; StatPearls skin entries
- The Lymphatic and Immune System: Tortora and OpenStax lymphatic chapters; Gray's lymphatic sections
- Special Senses: Tortora and OpenStax special senses chapters; Netter head and neck plates

References reviewed: August 2026. Next review: August 2027.

Course 3: Chemistry of Life

CORE TEXTS

- Timberlake, K. C., Chemistry: An Introduction to General, Organic, and Biological Chemistry, Pearson
- McMurry, J., et al., Fundamentals of General, Organic, and Biological Chemistry, Pearson
- OpenStax, Chemistry 2e, Rice University (open access)
- Atkins, P., de Paula, J., Physical Chemistry for the Life Sciences, Oxford University Press
- McMurry, J., Organic Chemistry, Cengage
- Nelson, D. L., Cox, M. M., Lehninger Principles of Biochemistry, Macmillan
- Berg, J. M., Tymoczko, J. L., Gatto, G. J., Stryer, L., Biochemistry, Macmillan

STANDARDS AND REGULATORY

- IUPAC nomenclature recommendations

LANDMARK PAPERS

- Pauling, L., The Nature of the Chemical Bond, Cornell University Press
- Henderson, L. J., "Concerning the relationship between the strength of acids and their capacity to preserve neutrality," American Journal of Physiology, 1908
- Anfinsen, C. B., "Principles that govern the folding of protein chains," Science, 1973

CURRENT REVIEWS

- Dill, K. A., MacCallum, J. L., "The protein-folding problem, 50 years on," Science, 2012
- Jumper, J., et al., "Highly accurate protein structure prediction with AlphaFold," Nature, 2021

CHAPTER ANCHORING

- Matter and Measurements: Timberlake; OpenStax Chemistry 2e
- Atoms and Elements: Timberlake; OpenStax; IUPAC nomenclature
- Molecules and Compounds: Timberlake; OpenStax; Pauling
- Properties of Water and Chemical Reactions: Timberlake; OpenStax; Atkins and de Paula
- Solution Stoichiometry and Introduction to Acids and Bases: OpenStax; Timberlake
- Acids and Bases: Atkins and de Paula; Sørensen; OpenStax
- Buffer Solutions: Henderson; Atkins and de Paula
- Redox Reactions: OpenStax; Timberlake
- Introduction to Organic Chemistry, Parts 1 and 2: McMurry, Organic Chemistry; McMurry GOB; IUPAC organic nomenclature
- Lipids and Carbohydrates: Lehninger; Timberlake biological chapters
- Amino Acids, Proteins, and Enzymes: Lehninger; Stryer; Anfinsen; Dill; AlphaFold

References reviewed: August 2026. Next review: August 2027.

Course 4: Human Physiology

CORE TEXTS

- Hall, J. E., Guyton and Hall Textbook of Medical Physiology, Elsevier

- Silverthorn, D. U., Human Physiology: An Integrated Approach, Pearson
- Boron, W. F., Boulpaep, E. L., Medical Physiology, Elsevier
- Barrett, K. E., et al., Ganong's Review of Medical Physiology, McGraw Hill
- Koeppen, B. M., Stanton, B. A., Berne and Levy Physiology, Elsevier
- OpenStax, Anatomy and Physiology 2e, Rice University (open access)

LANDMARK PAPERS

- Cannon, W. B., "Organization for physiological homeostasis," Physiological Reviews, 1929
- Hodgkin, A. L., Huxley, A. F., "A quantitative description of membrane current and its application to conduction and excitation in nerve," Journal of Physiology, 1952
- Neher, E., Sakmann, B., "Single-channel currents recorded from membrane of denervated frog muscle fibres," Nature, 1976
- Starling, E. H., "On the absorption of fluids from the connective tissue spaces," Journal of Physiology, 1896
- Guyton, A. C., "The relationship of cardiac output and arterial pressure control," Circulation, 1981
- Bayliss, W. M., Starling, E. H., "The mechanism of pancreatic secretion," Journal of Physiology, 1902
- Huxley, H. E., Hanson, J., "Changes in the cross-striations of muscle during contraction and stretch and their structural interpretation," Nature, 1954

CURRENT REVIEWS

- Physiological Reviews (American Physiological Society), the field's standing comprehensive review journal
- Comprehensive Physiology (Wiley), the field's standing review series
- StatPearls, NCBI Bookshelf, physiology entries, National Library of Medicine (open access)

CHAPTER ANCHORING

- Introduction to Human Physiology: Silverthorn ch. 1; Cannon 1929; Guyton and Hall introductory chapters
- The Nervous System: Guyton and Hall neurophysiology; Hodgkin and Huxley; Neher and Sakmann; Boron for membrane depth
- The Cardiovascular System: Guyton and Hall cardiovascular chapters; Starling 1896; Guyton 1981
- The Respiratory System: Guyton and Hall respiratory chapters; Boron gas transport
- The Digestive System: Guyton and Hall gastrointestinal chapters; Silverthorn
- The Urinary System: Guyton and Hall renal chapters; Boron renal depth
- The Endocrine System: Guyton and Hall endocrine chapters; Bayliss and Starling 1902; Silverthorn
- The Reproductive System: Guyton and Hall reproductive chapters; Ganong's
- The Lymphatic and Immune Systems: Silverthorn immune chapter; StatPearls immunology entries
- The Integumentary System: OpenStax integument; StatPearls skin physiology entries
- The Skeletal System: OpenStax bone tissue chapters; Berne and Levy calcium regulation
- The Muscular System: Guyton and Hall muscle chapters; Huxley and Hanson 1954; Silverthorn

References reviewed: August 2026. Next review: August 2027.

Course 5: Human Biology

CORE TEXTS

- Johnson, M. D., Human Biology: Concepts and Current Issues, Pearson
- Mader, S. S., Windelspecht, M., Human Biology, McGraw Hill
- OpenStax, Concepts of Biology, Rice University (open access)
- OpenStax, Biology 2e, Rice University (open access)
- Urry, L. A., et al., Campbell Biology, Pearson
- Alberts, B., et al., Essential Cell Biology, W. W. Norton

LANDMARK PAPERS

- Watson, J. D., Crick, F. H. C., "Molecular structure of nucleic acids: a structure for deoxyribose nucleic acid," Nature, 1953
- Meselson, M., Stahl, F. W., "The replication of DNA in Escherichia coli," PNAS, 1958
- Crick, F., "Central dogma of molecular biology," Nature, 1970
- Hanahan, D., Weinberg, R. A., "The hallmarks of cancer," Cell, 2000
- Thomson, J. A., et al., "Embryonic stem cell lines derived from human blastocysts," Science, 1998
- Takahashi, K., Yamanaka, S., "Induction of pluripotent stem cells from mouse embryonic and adult fibroblast cultures by defined factors," Cell, 2006
- Jinek, M., et al., "A programmable dual-RNA-guided DNA endonuclease in adaptive bacterial immunity," Science, 2012
- Darwin, C., On the Origin of Species, John Murray, 1859

CURRENT REVIEWS

- Hanahan, D., "Hallmarks of cancer: new dimensions," Cancer Discovery, 2022
- Doudna, J. A., Charpentier, E., "The new frontier of genome engineering with CRISPR-Cas9," Science, 2014
- International Human Genome Sequencing Consortium, "Initial sequencing and analysis of the human genome," Nature, 2001

CHAPTER ANCHORING

- Human Biology, Science, and Society: Johnson ch. 1; Mader introductory chapters
- The Chemistry of Living Things: Johnson; OpenStax Biology 2e chemistry unit
- Overview, Structure, and Function of Cells: Alberts, Essential Cell Biology; Campbell cell unit
- DNA and Chromosomes: Watson and Crick 1953; Campbell; Alberts
- DNA Replication: Meselson and Stahl 1958; Crick 1970; Alberts
- Cell Reproduction and Differentiation: Campbell cell cycle chapters; Alberts
- Cancer: Hanahan and Weinberg 2000; Hanahan 2022
- Genetics and Inheritance: Mendel 1866; Campbell genetics unit; Johnson
- Human Development: Mader development chapters; Johnson
- From Cells to Organ Systems: Johnson; OpenStax Concepts of Biology
- Stem Cells: Thomson 1998; Takahashi and Yamanaka 2006
- DNA Technology and Genetic Engineering: Jinek 2012; Doudna and Charpentier 2014; Human Genome 2001

- Evolution and Ecosystems: Darwin 1859; Campbell evolution and ecology units

References reviewed: August 2026. Next review: August 2027.

Course 6: Biomechanics

CORE TEXTS

- Hall, S. J., Basic Biomechanics, McGraw Hill
- Knudson, D., Fundamentals of Biomechanics, Springer
- Hamill, J., Knutzen, K. M., Biomechanical Basis of Human Movement, Wolters Kluwer
- Özkaya, N., et al., Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation, Springer
- Winter, D. A., Biomechanics and Motor Control of Human Movement, Wiley
- Nordin, M., Frankel, V. H., Basic Biomechanics of the Musculoskeletal System, Wolters Kluwer
- Fung, Y. C., Biomechanics: Mechanical Properties of Living Tissues, Springer
- Caro, C. G., Pedley, T. J., Schroter, R. C., Seed, W. A., The Mechanics of the Circulation, Cambridge University Press
- Whiting, W. C., Zernicke, R. F., Biomechanics of Musculoskeletal Injury, Human Kinetics
- Perry, J., Burnfield, J. M., Gait Analysis: Normal and Pathological Function, Slack

STANDARDS AND REGULATORY

- International Society of Biomechanics (ISB) recommendations on definitions of joint coordinate systems

LANDMARK PAPERS

- Hill, A. V., "The heat of shortening and the dynamic constants of muscle," Proceedings of the Royal Society B, 1938
- Huxley, H. E., Hanson, J., "Changes in the cross-striations of muscle during contraction and stretch and their structural interpretation," Nature, 1954
- Frost, H. M., "Bone's mechanostat: a 2003 update," The Anatomical Record Part A, 2003
- Mow, V. C., et al., "Biphasic creep and stress relaxation of articular cartilage in compression," Journal of Biomechanical Engineering, 1980
- Suter, S. P., Skalak, R., "The history of Poiseuille's law," Annual Review of Fluid Mechanics, 1993

CURRENT REVIEWS

- Cappozzo, A., et al., "Human movement analysis using stereophotogrammetry. Part 1: theoretical background," Gait and Posture, 2005
- Delp, S. L., et al., "OpenSim: open-source software to create and analyze dynamic simulations of movement," IEEE Transactions on Biomedical Engineering, 2007
- Hicks, J. L., et al., "Is my model good enough? Best practices for verification and validation of musculoskeletal models and simulations of movement," Journal of Biomechanical Engineering, 2015
- Journal of Biomechanics (Elsevier), the field's standing primary journal

CHAPTER ANCHORING

- Introduction and History of Biomechanics: Borelli 1680; Hall ch. 1; Knudson
- Linear and Angular Kinematics: Hall; Hamill and Knutzen; ISB coordinate conventions
- Linear Motion, Work, Energy, and Power: Hall; Özkaya

- Fundamentals of Mechanics and Qualitative Analysis: Knudson; Özkaya
- Anatomical Definitions and Muscle Structures: Hamill and Knutzen; Nordin and Frankel
- Muscle Movements and the Skeletal-Muscular System: Hill 1938; Huxley and Hanson 1954; Winter
- Bone Physiology and Bone Fractures: Wolff 1892; Frost 2003; Nordin and Frankel bone chapters
- Structure and Mechanical Properties of Joints: Mow 1980; Fung; Nordin and Frankel joint chapters
- Mechanics of the Cardiovascular System: Caro et al.; Fung
- Fluid Mechanics: Caro et al.; Suter and Skalak 1993
- Biomechanics of Injury and Rehabilitation: Whiting and Zernicke; Nordin and Frankel
- Human Motion Analysis: Winter; Perry; Cappozzo 2005; Delp 2007; Hicks 2015

References reviewed: August 2026. Next review: August 2027.

Course 7: Biomaterials

CORE TEXTS

- Ratner, B. D., Hoffman, A. S., Schoen, F. J., Lemons, J. E. (eds.), Biomaterials Science: An Introduction to Materials in Medicine, Elsevier
- Temenoff, J. S., Mikos, A. G., Biomaterials: The Intersection of Biology and Materials Science, Pearson
- Park, J., Lakes, R. S., Biomaterials: An Introduction, Springer
- Williams, D. F., Essential Biomaterials Science, Cambridge University Press
- Williams, D. F., The Williams Dictionary of Biomaterials, Liverpool University Press

STANDARDS AND REGULATORY

- ISO 10993 series, Biological Evaluation of Medical Devices

LANDMARK PAPERS

- Hench, L. L., "Bioceramics: from concept to clinic," Journal of the American Ceramic Society, 1991
- Williams, D. F., "On the mechanisms of biocompatibility," Biomaterials, 2008
- Vroman, L., Adams, A. L., "Findings with the recording ellipsometer suggesting rapid exchange of specific plasma proteins at liquid/solid interfaces," Surface Science, 1969
- Anderson, J. M., Rodriguez, A., Chang, D. T., "Foreign body reaction to biomaterials," Seminars in Immunology, 2008
- Discher, D. E., Janmey, P., Wang, Y.-L., "Tissue cells feel and respond to the stiffness of their substrate," Science, 2005
- Gorbet, M. B., Sefton, M. V., "Biomaterial-associated thrombosis: roles of coagulation factors, complement, platelets and leukocytes," Biomaterials, 2004
- Gristina, A. G., "Biomaterial-centered infection: microbial adhesion versus tissue integration," Science, 1987

CURRENT REVIEWS

- Hoffman, A. S., "Hydrogels for biomedical applications," Advanced Drug Delivery Reviews, 2012
- Ratner, B. D., Bryant, S. J., "Biomaterials: where we have been and where we are going," Annual Review of Biomedical Engineering, 2004

- Langer, R., Peppas, N. A., "Advances in biomaterials, drug delivery, and bionanotechnology," AIChE Journal, 2003
- Wilson, C. J., et al., "Mediation of biomaterial-cell interactions by adsorbed proteins: a review," Tissue Engineering, 2005

CHAPTER ANCHORING

- Introduction to Biomaterials: Ratner Part I; Williams Dictionary for all definitions; Ratner and Bryant 2004
- Types of Biomaterials: Ratner materials chapters; Park and Lakes; Hench 1991 (ceramics); Hoffman 2012
- Biocompatibility and Tissue Interaction: Williams 2008; ISO 10993; Temenoff and Mikos
- Mechanical Properties of Biomaterials: Park and Lakes; Ratner properties chapters
- Biomaterial Degradation and Processing: Ratner degradation chapters; ISO 10993 degradation parts
- Surface Properties of Biomaterials: Ratner surface chapters; Williams, Essential Biomaterials Science
- Protein Interactions with Biomaterials: Vroman 1969; Wilson 2005
- Cell Interaction with Biomaterials: Discher 2005; Temenoff and Mikos
- The Immune Response to Biomaterials: Anderson 2008; Ratner host-response chapters
- Biomaterials and Thrombosis: Gorbet and Sefton 2004; ISO 10993-4 hemocompatibility
- Implantation, Acute Inflammation, and Wound Healing: Anderson 2008; Ratner host-response chapters
- Infection, Tumorigenesis, and Calcification: Gristina 1987; Ratner pathology chapters
- Protein and Cellular Response to Biomaterials: Vroman 1969; Wilson 2005; Discher 2005
- Advanced Applications of Biomaterials in Medicine: Langer and Peppas 2003; Ratner applications chapters

References reviewed: August 2026. Next review: August 2027.

Course 8: Signals and Systems

CORE TEXTS

- Oppenheim, A. V., Willsky, A. S., Nawab, S. H., Signals and Systems, Pearson
- Lathi, B. P., Green, R. A., Linear Systems and Signals, Oxford University Press
- Haykin, S., Van Veen, B., Signals and Systems, Wiley
- Oppenheim, A. V., Schafer, R. W., Discrete-Time Signal Processing, Pearson
- Proakis, J. G., Manolakis, D. G., Digital Signal Processing: Principles, Algorithms, and Applications, Pearson
- Lyons, R. G., Understanding Digital Signal Processing, Pearson

LANDMARK PAPERS

- Nyquist, H., "Certain topics in telegraph transmission theory," Transactions of the AIEE, 1928
- Shannon, C. E., "Communication in the presence of noise," Proceedings of the IRE, 1949
- Cooley, J. W., Tukey, J. W., "An algorithm for the machine calculation of complex Fourier series," Mathematics of Computation, 1965

CURRENT REVIEWS

- Heideman, M. T., Johnson, D. H., Burrus, C. S., "Gauss and the history of the fast Fourier transform," IEEE ASSP Magazine, 1984
- IEEE Signal Processing Magazine, the field's standing tutorial and review venue

CHAPTER ANCHORING

- Introduction to Signals and Systems: Oppenheim ch. 1; Lathi
- Basic Continuous-Time and Discrete-Time Signals: Oppenheim ch. 1; Haykin and Van Veen
- Convolution: Oppenheim ch. 2; Lathi
- Properties of LTI Systems: Oppenheim ch. 2; Haykin and Van Veen
- Systems Represented by Differential and Difference Equations: Oppenheim ch. 2; Lathi
- Fourier Series, Continuous-Time: Fourier 1822; Oppenheim ch. 3
- Fourier Series, Discrete-Time: Oppenheim ch. 3; Oppenheim and Schaffer
- Sampling and Reconstruction of Signals: Nyquist 1928; Shannon 1949; Oppenheim ch. 7
- Continuous-Time Fourier Transform: Oppenheim ch. 4; Lathi
- Properties of the Continuous-Time Fourier Transform: Oppenheim ch. 4
- Systems Characterized by Linear Constant-Coefficient Differential Equations: Oppenheim chs. 4 and 6; Lathi
- Discrete Fourier Transform and Sampling: Cooley and Tukey 1965; Oppenheim and Schaffer; Proakis; Heideman 1984
- The Laplace Transform: Oppenheim ch. 9; Lathi
- The z-Transform: Oppenheim ch. 10; Oppenheim and Schaffer; Lyons

References reviewed: August 2026. Next review: August 2027.

Course 9: Biostatistics

CORE TEXTS

- Rosner, B., Fundamentals of Biostatistics, Cengage
- Pagano, M., Gauvreau, K., Principles of Biostatistics, CRC Press
- Daniel, W. W., Cross, C. L., Biostatistics: A Foundation for Analysis in the Health Sciences, Wiley
- Motulsky, H., Intuitive Biostatistics, Oxford University Press
- Glantz, S. A., Primer of Biostatistics, McGraw Hill
- Kirkwood, B. R., Sterne, J. A. C., Essential Medical Statistics, Wiley-Blackwell

LANDMARK PAPERS

- Student (Gosset, W. S.), "The probable error of a mean," Biometrika, 1908
- Pearson, K., "On the criterion that a given system of deviations from the probable in the case of a correlated system of variables is such that it can be reasonably supposed to have arisen from random sampling," Philosophical Magazine, 1900
- Fisher, R. A., Statistical Methods for Research Workers, Oliver and Boyd, 1925
- Neyman, J., Pearson, E. S., "On the problem of the most efficient tests of statistical hypotheses," Philosophical Transactions of the Royal Society A, 1933

- Neyman, J., "Outline of a theory of statistical estimation based on the classical theory of probability," Philosophical Transactions of the Royal Society A, 1937
- Wilcoxon, F., "Individual comparisons by ranking methods," Biometrics Bulletin, 1945
- Mann, H. B., Whitney, D. R., "On a test of whether one of two random variables is stochastically larger than the other," Annals of Mathematical Statistics, 1947
- Kruskal, W. H., Wallis, W. A., "Use of ranks in one-criterion variance analysis," Journal of the American Statistical Association, 1952
- Friedman, M., "The use of ranks to avoid the assumption of normality implicit in the analysis of variance," Journal of the American Statistical Association, 1937
- McNemar, Q., "Note on the sampling error of the difference between correlated proportions or percentages," Psychometrika, 1947
- Galton, F., "Regression towards mediocrity in hereditary stature," Journal of the Anthropological Institute, 1886

CURRENT REVIEWS

- Greenland, S., et al., "Statistical tests, P values, confidence intervals, and power: a guide to misinterpretations," European Journal of Epidemiology, 2016
- Wasserstein, R. L., Lazar, N. A., "The ASA statement on p-values: context, process, and purpose," The American Statistician, 2016
- Krzywinski, M., Altman, N., "Points of Significance" series, Nature Methods
- Ioannidis, J. P. A., "Why most published research findings are false," PLoS Medicine, 2005

CHAPTER ANCHORING

- Introduction to Biostatistics: Rosner ch. 1; Motulsky
- Descriptive Statistics: Rosner; Pagano
- Probability Theory: Rosner probability chapters; Daniel
- Sampling Distributions and the Central Limit Theorem: Rosner; Pagano
- ANOVA: Fisher 1925; Rosner ANOVA chapters; Glantz
- The t-Test: Student 1908; Rosner; Motulsky
- Contingency Tables, Chi-Square, z-Test: Pearson 1900; Rosner categorical chapters
- Fisher Exact Test, Relative Risk, Odds Ratio: Fisher 1925; Kirkwood and Sterne epidemiological chapters
- Power and Sample Size: Neyman and Pearson 1933; Cohen, Statistical Power Analysis for the Behavioral Sciences, Routledge
- Paired t-Test, Repeated Measures ANOVA, McNemar's Test: McNemar 1947; Glantz repeated measures chapters
- Nonparametric Tests, Mann-Whitney and Wilcoxon: Wilcoxon 1945; Mann and Whitney 1947
- Nonparametric Tests, Kruskal-Wallis and Friedman: Kruskal and Wallis 1952; Friedman 1937
- Confidence Intervals: Neyman 1937; Greenland 2016
- Correlation and Regression: Galton 1886; Rosner regression chapters

References reviewed: August 2026. Next review: August 2027.

Course 10: Modeling and Simulation

CORE TEXTS

- Kluever, C. A., Dynamic Systems: Modeling, Simulation, and Control, Wiley
- Palm, W. J., System Dynamics, McGraw Hill
- Ogata, K., System Dynamics, Pearson
- Close, C. M., Frederick, D. K., Newell, J. C., Modeling and Analysis of Dynamic Systems, Wiley
- Ogata, K., Modern Control Engineering, Pearson
- Nise, N. S., Control Systems Engineering, Wiley

LANDMARK PAPERS

- Bode, H. W., Network Analysis and Feedback Amplifier Design, Van Nostrand, 1945
- Nyquist, H., "Regeneration theory," Bell System Technical Journal, 1932
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- Åström, K. J., Murray, R. M., Feedback Systems: An Introduction for Scientists and Engineers, Princeton University Press
- Simulink Documentation and Modeling Guidance, MathWorks

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- Basic Definitions and Introduction: Kluever ch. 1; Palm; Maxwell 1868 for historical framing
- Modeling of Mechanical Systems: Kluever; Palm mechanical chapters
- Modeling Electrical Systems: Kluever; Ogata, System Dynamics
- Modeling Electromechanical Systems: Kluever; Close, Frederick, Newell
- Modeling Fluid and Thermal Systems: Palm fluid and thermal chapters; Kluever
- State-Variable Equations, State-Space, Linearization: Kalman 1960; Kluever state-space chapters; Ogata, Modern Control Engineering
- Input-Output Equations, Transfer Functions, Block Diagrams: Kluever; Nise; Ogata
- Analytical Solutions, First- and Second-Order Response: Kluever response chapters; Palm
- System Analysis Using Laplace Transforms: Ogata, Modern Control Engineering; Kluever
- Frequency Response: Nyquist 1932; Ogata; Nise
- Bode Diagrams: Bode 1945; Ogata; Åström and Murray

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Course 11: Instrumentation

CORE TEXTS

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- Cromwell, L., Weibell, F. J., Pfeiffer, E. A., Biomedical Instrumentation and Measurements, Pearson
- Carr, J. J., Brown, J. M., Introduction to Biomedical Equipment Technology, Pearson
- Khandpur, R. S., Handbook of Biomedical Instrumentation, McGraw Hill

- Togawa, T., Tamura, T., Öberg, P. Å., Biomedical Sensors and Instruments, CRC Press
- Horowitz, P., Hill, W., The Art of Electronics, Cambridge University Press

STANDARDS AND REGULATORY

- IEC 60601-1, Medical Electrical Equipment: General Requirements for Basic Safety and Essential Performance
- IEC 60601-2-49, Multifunction Patient Monitoring Equipment
- AAMI/ANSI EC12, Disposable ECG Electrodes

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- Geddes, L. A., Baker, L. E., "The specific resistance of biological material," Medical and Biological Engineering, 1967
- Webster, J. G., "Reducing motion artifacts and interference in biopotential recording," IEEE Transactions on Biomedical Engineering, 1984

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- Neuman, M. R., "Biopotential electrodes" and "Biopotential amplifiers," in Webster (ed.), Medical Instrumentation, Wiley
- Ko, W. H., "Early history and challenges of implantable electronics," ACM Journal on Emerging Technologies in Computing Systems, 2012
- IEEE Reviews in Biomedical Engineering, standing reviews in sensing and instrumentation

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- Basic Medical Instrumentation Concepts: Webster ch. 1; Cromwell introductory chapters
- General Terms and Definitions: Webster ch. 1
- Fundamentals of Biostatistics: Webster ch. 1 statistics of measurement; Rosner, Fundamentals of Biostatistics, Cengage
- Sensors and Working Principles: Togawa; Webster sensor chapters; Khandpur
- Bioelectric Potentials: Einthoven 1906; Cromwell bioelectric chapters; Geddes and Baker 1967
- Biopotential Electrodes: Neuman in Webster; AAMI EC12
- Biopotential Amplifiers: Neuman in Webster; Horowitz and Hill; Webster 1984
- Digital Signal Processing in Medical Instrumentation: Webster DSP sections; Rangayyan, Biomedical Signal Analysis, Wiley-IEEE Press
- Blood Pressure and Heart Sound Measurement: Korotkoff 1905; Webster pressure and sound chapters
- Blood Flow and Volume Measurement: Fick 1870; Webster flow chapters; Cromwell
- Respiratory System Measurements: Webster respiratory chapters; Carr and Brown
- Imaging Methods and General Concepts: Webster imaging chapter; Bushberg, The Essential Physics of Medical Imaging, Wolters Kluwer

References reviewed: August 2026. Next review: August 2027.

Course 12: Cell and Tissue Engineering

CORE TEXTS

- Lanza, R., Langer, R., Vacanti, J., Atala, A. (eds.), Principles of Tissue Engineering, Elsevier

- Pålsson, B. Ø., Bhatia, S. N., Tissue Engineering, Pearson
- Yannas, I. V., Tissue and Organ Regeneration in Adults, Springer
- Alberts, B., et al., Molecular Biology of the Cell, W. W. Norton

STANDARDS AND REGULATORY

- U.S. FDA, 21 CFR Part 1271, Human Cells, Tissues, and Cellular and Tissue-Based Products
- EU Regulation (EC) 1394/2007, Advanced Therapy Medicinal Products framework

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- Langer, R., Vacanti, J. P., "Tissue engineering," Science, 1993
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- Khademhosseini, A., Langer, R., "A decade of progress in tissue engineering," Nature Protocols, 2016
- Hollister, S. J., "Porous scaffold design for tissue engineering," Nature Materials, 2005
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- Tissue Engineering: Langer and Vacanti 1993; Lanza introductory chapters
- Surface Immobilization of Adhesion Ligands: Hubbell 1995; Lanza surface-modification chapters
- Biomaterials, Protein-Surface Interactions: Lanza; Ratner, Biomaterials Science, Elsevier
- Engineering Biomaterials, the 10-100 Micron Size Scale: Lanza; Hollister 2005
- Regeneration Templates: Yannas and Burke 1980; Yannas, Tissue and Organ Regeneration in Adults
- Fluid Shear Stress Effects on Cellular Function: Dewey 1981; Pålsson and Bhatia bioreactor chapters
- The Biology of Stem Cells: Thomson 1998; Takahashi and Yamanaka 2006; Engler 2006
- Cell Motility and Tissue Architecture: Alberts cytoskeleton and tissue chapters; Pålsson and Bhatia
- Bioactive Scaffolds: Hollister 2005; Hussey 2018; Lanza scaffold chapters
- The Importance of Stromal Cells: Caplan 1991; Lanza stromal chapters

- Tissue Engineering of Bone and Skeletal Muscle: Lanza organ-specific chapters; Caplan 1991
- Tissue Engineering of the Liver and Cartilage: Lanza organ-specific chapters; Mow 1980 for cartilage mechanics context
- Tissue Engineering in the Nervous System: Schmidt and Leach 2003; Lanza neural chapters
- Tissue Engineering of the Kidney: Lanza kidney chapter; Atala 2006 for the engineered-organ precedent

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Course 13: Therapeutic Devices

CORE TEXTS

- Webster, J. G. (ed.), Encyclopedia of Medical Devices and Instrumentation, Wiley
- Kramme, R., Hoffmann, K.-P., Pozos, R. S. (eds.), Springer Handbook of Medical Technology, Springer
- Bronzino, J. D. (ed.), Medical Devices and Systems, CRC Press
- Iadanza, E. (ed.), Clinical Engineering Handbook, Elsevier
- Khandpur, R. S., Handbook of Biomedical Instrumentation, McGraw Hill

STANDARDS AND REGULATORY

- IEC 60601-1, general safety standard governing all device chapters
- ISO 14708-2, Active Implantable Medical Devices: Cardiac Pacemakers
- IEC 60601-2-4, Cardiac Defibrillators
- ISO 8637 series, Extracorporeal Systems for Blood Purification
- ISO 80601-2-12, Critical Care Ventilators
- IEC 60601-2-24, Infusion Pumps and Controllers
- IEC 60601-2-2, High Frequency Surgical Equipment
- ISO 14708-7, Active Implantable Medical Devices: Cochlear Implant Systems
- ISO 7206 series, Implants for Surgery: Partial and Total Hip Joint Prostheses

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- Cushing, H., "Electro-surgery as an aid to the removal of intracranial tumors," Surgery, Gynecology and Obstetrics, 1928
- Wilson, B. S., et al., "Better speech recognition with cochlear implants," Nature, 1991
- Charnley, J., "Arthroplasty of the hip: a new operation," The Lancet, 1961
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- Wilson, B. S., Dorman, M. F., "Cochlear implants: a remarkable past and a brilliant future," Hearing Research, 2008

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- Introduction: Webster Encyclopedia; Greatbatch and Holmes 1991; IEC 60601-1
- Cardiac Pacemakers: Zoll 1952; Larsson 2003; ISO 14708-2; Webster pacemaker entry
- Defibrillators: Zoll 1956; Mirowski 1980; IEC 60601-2-4
- Cardiac Assist Devices, IABP: Kantrowitz 1968; Kramme cardiac assist chapters
- Renal and Hemodialysis: Kolff 1944; ISO 8637; Kramme dialysis chapters
- Lithotripsy: Chaussy 1980; Webster lithotripsy entry
- Ventilators: Lassen 1953; ARDSNet 2000; ISO 80601-2-12
- Drug Infusion Pumps: IEC 60601-2-24; Webster infusion entry; Khandpur
- Electrosurgical Units: Cushing 1928; IEC 60601-2-2; Kramme electrosurgery chapters
- Cochlear Implants: Wilson 1991; Wilson and Dorman 2008; ISO 14708-7
- Orthopedic Implants and Prosthetics: Charnley 1961; ISO 7206; Bronzino orthopedic chapters
- Insulin Pumps: Pickup 1978; IEC 60601-2-24; Kramme diabetes technology chapters

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Course 14: Medical Imaging Physics

CORE TEXTS

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- Hendee, W. R., Ritenour, E. R., Medical Imaging Physics, Wiley
- Cherry, S. R., Sorenson, J. A., Phelps, M. E., Physics in Nuclear Medicine, Elsevier
- Kalender, W. A., Computed Tomography: Fundamentals, System Technology, Image Quality, Applications, Wiley
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- McRobbie, D. W., Moore, E. A., Graves, M. J., Prince, M. R., MRI from Picture to Proton, Cambridge University Press
- IAEA, Diagnostic Radiology Physics: A Handbook for Teachers and Students, International Atomic Energy Agency (open access)
- IAEA, Nuclear Medicine Physics: A Handbook for Teachers and Students, International Atomic Energy Agency (open access)

STANDARDS AND REGULATORY

- ICRP Publication 103, The 2007 Recommendations of the International Commission on Radiological Protection
- IAEA SSG-46, Radiation Protection and Safety in Medical Uses of Ionizing Radiation
- IEC 60601-2-44 (CT), IEC 60601-2-45 (mammography), IEC 60601-2-37 (ultrasound), IEC 60601-2-33 (MR), modality safety standards
- U.S. Mammography Quality Standards Act (MQSA) framework
- ACR Appropriateness Criteria

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- Cormack, A. M., "Representation of a function by its line integrals, with some radiological applications," Journal of Applied Physics, 1963
- Hounsfield, G. N., "Computerized transverse axial scanning (tomography): Part 1. Description of system," British Journal of Radiology, 1973
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- Tabár, L., et al., "Reduction in mortality from breast cancer after mass screening with mammography," The Lancet, 1985
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- McCollough, C. H., et al., "Dual- and multi-energy CT: principles, technical approaches, and clinical applications," Radiology, 2015
- Lohrke, J., et al., "25 years of contrast-enhanced MRI: developments, current challenges and future perspectives," Advances in Therapy, 2016
- Willmann, J. K., et al., "Molecular imaging in drug development," Nature Reviews Drug Discovery, 2008

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- Introduction to Medical Imaging: Bushberg ch. 1; Röntgen 1896; IAEA handbook ch. 1
- X-Ray Imaging Physics: Bushberg X-ray chapters; Hendee; IAEA handbook

- Computed Tomography: Cormack 1963; Hounsfield 1973; Kalender; Brenner and Hall 2007
- Magnetic Resonance Imaging: Lauterbur 1973; McRobbie; IEC 60601-2-33
- Ultrasound Imaging: Wild and Reid 1952; Hoskins; IEC 60601-2-37
- Nuclear Medicine Imaging: Anger 1958; Ter-Pogossian 1975; Cherry; IAEA Nuclear Medicine handbook
- Radiation Safety and Dosimetry: ICRP 103; IAEA SSG-46; Bushberg dosimetry chapters
- Mammography and Breast Imaging: Tabár 1985; IEC 60601-2-45; MQSA framework; Bushberg mammography chapter
- Image Processing in Medical Imaging: Bushberg image quality chapters; Gonzalez, R. C., Woods, R. E., Digital Image Processing, Pearson
- Functional and Molecular Imaging: Ogawa 1990; Willmann 2008; Cherry molecular imaging chapters
- Advanced MRI Techniques: McRobbie advanced chapters; McCollough 2015 for spectral methods context
- Image Artifacts and Quality Control: Bushberg artifacts and QC chapters; IAEA handbook QC sections
- Contrast Agents in Medical Imaging: Lohrke 2016; Bushberg contrast chapters
- Ethics, Regulatory, and Legal Considerations: ICRP 103 justification and optimisation principles; ACR Appropriateness Criteria; IAEA SSG-46

References reviewed: August 2026. Next review: August 2027.

Course 15: Device Design

CORE TEXTS

- Yock, P., Zenios, S., Makower, J., et al., Biodesign: The Process of Innovating Medical Technologies, Cambridge University Press
- Ogrodnik, P. J., Medical Device Design: Innovation from Concept to Market, Elsevier
- Fries, R. C., Reliable Design of Medical Devices, CRC Press
- Ratner, B. D., et al. (eds.), Biomaterials Science, Elsevier
- Webster, J. G. (ed.), Medical Instrumentation: Application and Design, Wiley
- Wiklund, M. E., Kendler, J., Strohlic, A. Y., Usability Testing of Medical Devices, CRC Press

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- ISO 13485, Quality Management Systems for Medical Devices
- ISO 14971, Application of Risk Management to Medical Devices
- IEC 62304, Medical Device Software Life Cycle Processes
- IEC 62366-1, Application of Usability Engineering to Medical Devices
- U.S. FDA, 21 CFR Part 820 and Design Control Guidance for Medical Device Manufacturers
- U.S. FDA, Applying Human Factors and Usability Engineering to Medical Devices
- EU Regulation 2017/745 (MDR)
- ISO 14155, Clinical Investigation of Medical Devices for Human Subjects: Good Clinical Practice
- ASME V&V 40, Assessing Credibility of Computational Modeling: Application to Medical Devices
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- Kaplan, A. V., et al., "Medical device development: from prototype to regulatory approval," Circulation, 2004
- Pietzsch, J. B., et al., "Stage-gate process for the development of medical devices," Journal of Medical Devices, 2009
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- Cohen, D., "How safe are metal-on-metal hip implants?," BMJ, 2012

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- Van Norman, G. A., "Drugs, devices, and the FDA: Part 2, an overview of approval processes for medical devices," JACC: Basic to Translational Science, 2016
- Viceconti, M., et al., "In silico trials: verification, validation and uncertainty quantification of predictive models," Methods, 2021

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- Introduction to Biomedical Device Design: Biodesign Part I; Kaplan 2004; Pietzsch 2009
- Biomedical Materials Science: Ratner; ISO 10993 series, Biological Evaluation of Medical Devices
- Biomechanics and Device Interaction with Human Anatomy: Nordin and Frankel, Basic Biomechanics of the Musculoskeletal System, Wolters Kluwer; Ogrodnik anatomical design chapters
- Bioinstrumentation and Sensor Integration: Webster; Ogrodnik
- Medical Device Prototyping and Manufacturing: Biodesign implementation chapters; Fries; ISO 13485 production controls
- Human Factors Engineering and Usability: IEC 62366-1; FDA Human Factors guidance; Wiklund
- Regulations, Ethics, and Standards: 21 CFR 820; EU MDR; ISO 14971; Declaration of Helsinki; Van Norman 2016
- Medical Imaging and Diagnostic Devices: Bushberg, The Essential Physics of Medical Imaging, Wolters Kluwer; Biodesign diagnostics cases
- Computational Methods and Simulation in Device Design: ASME V&V 40; Viceconti 2021
- Clinical Trials, Testing, and Validation: ISO 14155; Declaration of Helsinki; Biodesign clinical strategy chapters
- Case Studies in Successful and Failed Medical Devices: Leveson and Turner 1993; Cohen 2012; Biodesign case studies throughout

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Course 16: Medical Imaging

CORE TEXTS

- Bushberg, J. T., Seibert, J. A., Leidholdt, E. M., Boone, J. M., The Essential Physics of Medical Imaging, Wolters Kluwer
- Curry, T. S., Dowdey, J. E., Murry, R. C., Christensen's Physics of Diagnostic Radiology, Wolters Kluwer
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- Smith, N. B., Webb, A., Introduction to Medical Imaging, Cambridge University Press

- Hoskins, P. R., Martin, K., Thrush, A., Diagnostic Ultrasound: Physics and Equipment, CRC Press
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- IAEA, Diagnostic Radiology Physics: A Handbook for Teachers and Students, IAEA (open access)

STANDARDS AND REGULATORY

- IEC 60336, X-ray Tube Assemblies: Focal Spot Dimensions and Related Characteristics
- IEC 60601-2-44 (CT) and IEC 60601-2-45 (mammography), modality safety standards
- ICRP Publication 103

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- Compton, A. H., "A quantum theory of the scattering of X-rays by light elements," Physical Review, 1923
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- McCollough, C. H., et al., "Dual- and multi-energy CT," Radiology, 2015
- Seibert, J. A., "X-ray imaging physics for nuclear medicine technologists. Part 1: Basic principles of X-ray production," Journal of Nuclear Medicine Technology, 2004

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- Introduction and Overview of Modalities: Smith and Webb; Bushberg ch. 1; Röntgen 1896
- MRI, Ultrasound, Doppler Ultrasound overview: Smith and Webb; Hoskins; Doppler 1842
- Nuclear Medicine, SPECT, PET, Combined Modalities: Cherry; Anger 1958
- X-ray Production, Tubes, Generators, Bremsstrahlung and Characteristic Spectra: Curry; Bushberg X-ray production chapter; Seibert 2004
- X-ray Tubes, Cathode, Anode: Coolidge 1913; Curry tube chapters
- Anode Configurations and Focal Spot Measurement: IEC 60336; Curry; Bushberg
- Anode Angle, Heel Effect, Off-focal Radiation, Collimators: Bushberg; Curry
- Filtration, Attenuation, Coefficients, HVL: Bushberg attenuation chapter; IAEA handbook; ICRP 103
- Mammography and Focal Spot Considerations: IEC 60601-2-45; Bushberg mammography chapter
- Tube Port, Filtration, Beam Quality, Magnification: Curry; Bushberg
- CT System Designs, Concepts, Definitions: Kalender; Hsieh
- CT Tubes, Filters, Collimation, Rayleigh and Compton Interactions: Compton 1923; Hsieh; Kalender
- The Photoelectric Effect: Einstein 1905; Bushberg interactions chapter
- Hounsfield Unit: Hounsfield 1973; Kalender

References reviewed: August 2026. Next review: August 2027.

Course 17: MRI Physics

CORE TEXTS

- McRobbie, D. W., Moore, E. A., Graves, M. J., Prince, M. R., MRI from Picture to Proton, Cambridge University Press
- Elster, A. D., Burdette, J. H., Questions and Answers in Magnetic Resonance Imaging, Mosby
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- Bernstein, M. A., King, K. F., Zhou, X. J., Handbook of MRI Pulse Sequences, Elsevier
- Nishimura, D. G., Principles of Magnetic Resonance Imaging

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- IEC 60601-2-33, Magnetic Resonance Equipment for Medical Diagnosis
- ACR Manual on MR Safety
- Kanal, E., et al., "ACR guidance document on MR safe practices: 2013," Journal of Magnetic Resonance Imaging, 2013

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- Twieg, D. B., "The k-trajectory formulation of the NMR imaging process with applications in analysis and synthesis of imaging methods," Medical Physics, 1983
- Ljunggren, S., "A simple graphical representation of Fourier-based imaging methods," Journal of Magnetic Resonance, 1983

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- Plewes, D. B., Kucharczyk, W., "Physics of MRI: a primer," Journal of Magnetic Resonance Imaging, 2012
- Pruessmann, K. P., et al., "SENSE: sensitivity encoding for fast MRI," Magnetic Resonance in Medicine, 1999
- Zaitsev, M., Maclaren, J., Herbst, M., "Motion artifacts in MRI: a complex problem with many partial solutions," Journal of Magnetic Resonance Imaging, 2015

CHAPTER ANCHORING

- Magnets and Scanners: McRobbie hardware chapters; IEC 60601-2-33
- Types of Magnets: McRobbie; Elster magnet entries
- Homogeneity, Shimming: Brown et al.; Elster
- Gradient Coils: Bernstein gradient chapters; IEC 60601-2-33 gradient output clauses
- RF Coils, MR Site Planning: McRobbie; ACR Manual on MR Safety; Kanal 2013

- The NMR Phenomenon, Spin, Precession: Rabi 1938; Bloch 1946; Purcell 1946
- Resonance, Larmor Frequency, Flip Angle: Bloch 1946; McRobbie; Elster
- Relaxation Physics, T1, T2: Damadian 1971; Brown et al. relaxation chapters
- Pulse Sequences, Gradient Echo, TR and TE, Spin Echo: Hahn 1950; Bernstein; McRobbie
- Image Contrast, Short and Long TR/TE: McRobbie contrast chapters; Elster
- Inversion Recovery, Choice of IR Parameters: Bernstein IR chapters; Elster
- Making an Image, Phase and Frequency, Fourier Transform: Lauterbur 1973; Kumar, Welte, Ernst 1975; Nishimura
- Frequency Encoding, Phase Encoding: Kumar, Welte, Ernst 1975; Nishimura
- K-Space, Parts of K-Space: Twieg 1983; Ljunggren 1983; Nishimura

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Course 18: Rehabilitation Engineering

CORE TEXTS

- Cooper, R. A., Ohnabe, H., Hobson, D. A. (eds.), An Introduction to Rehabilitation Engineering, CRC Press
- Cifu, D. X. (ed.), Braddom's Physical Medicine and Rehabilitation, Elsevier
- Winter, D. A., Biomechanics and Motor Control of Human Movement, Wiley
- Perry, J., Burnfield, J. M., Gait Analysis: Normal and Pathological Function, Slack
- Cook, A. M., Polgar, J. M., Assistive Technologies: Principles and Practice, Elsevier
- Smith, D. G., Michael, J. W., Bowker, J. H. (eds.), Atlas of Amputations and Limb Deficiencies, AAOS

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- ISO 7176 series, Wheelchairs
- ISO 22523, External Limb Prostheses and External Orthoses
- WHO, International Classification of Functioning, Disability and Health (ICF), 2001
- WHO, Global Report on Assistive Technology, 2022

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- Liberson, W. T., et al., "Functional electrotherapy: stimulation of the peroneal nerve synchronized with the swing phase of the gait of hemiplegic patients," Archives of Physical Medicine and Rehabilitation, 1961
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- Wilson, B. S., et al., "Better speech recognition with cochlear implants," Nature, 1991
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- Taub, E., et al., "Technique to improve chronic motor deficit after stroke," Archives of Physical Medicine and Rehabilitation, 1993

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- Esquenazi, A., et al., "The ReWalk powered exoskeleton to restore ambulatory function to individuals with thoracic-level motor-complete spinal cord injury," American Journal of Physical Medicine and Rehabilitation, 2012
- Dobkin, B. H., "Strategies for stroke rehabilitation," The Lancet Neurology, 2004
- Anderson, L., et al., "Exercise-based cardiac rehabilitation for coronary heart disease," Cochrane Database of Systematic Reviews, 2016
- Journal of NeuroEngineering and Rehabilitation (BMC), the field's standing open-access journal

CHAPTER ANCHORING

- Introduction to Rehabilitation Engineering: Cooper ch. 1; WHO ICF framework
- Assistive Technology Devices: Cook and Polgar; WHO Global Report 2022
- Prosthetics and Orthotics: AAOS Atlas; ISO 22523
- Rehabilitation Robotics: Krebs 1998; Colombo 2000; Esquenazi 2012; Reinkensmeyer 2012
- Neuromuscular Rehabilitation Technologies: Liberson 1961; Cooper FES chapters
- Sensory Rehabilitation Engineering: Wilson 1991; Cooper sensory chapters
- Human-Machine Interfaces in Rehabilitation: Wolpaw 2002; Cooper HMI chapters
- Biomechanics of Rehabilitation: Winter; Perry
- Rehabilitation for Neurological Conditions: Dobkin 2004; Taub 1993; Braddom's neurological chapters
- Rehabilitation for Musculoskeletal Disorders: Braddom's musculoskeletal chapters; Nordin and Frankel, Basic Biomechanics of the Musculoskeletal System, Wolters Kluwer
- Pediatric Rehabilitation Engineering: Braddom's pediatric chapters; Cook and Polgar pediatric AT sections
- Geriatric Rehabilitation Engineering: Braddom's geriatric chapters; WHO Global Report 2022
- Outcome Measurement and Evaluation: WHO ICF, 2001; Braddom's outcomes chapters
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- Artificial Kidney: Kolff 1944; ISO 8637; Daugirdas
- Peritoneal Dialysis Equipment: Popovich and Moncrief 1978; Daugirdas PD chapters
- Therapeutic Apheresis and Blood Fractionation: ASFA guidelines; Webster apheresis entry
- Liver Support Systems: Bañares 2013; Kramme extracorporeal chapters
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- Nanotechnology in Drug Delivery: Matsumura and Maeda 1986; Barenholz 2012; Mitchell 2021
- Nanotechnology in Diagnostics: Michalet 2005; Mirkin 1996; Jain diagnostics chapters
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- Nanotechnology in Tissue Engineering: Bhushan; Lanza, Principles of Tissue Engineering, Elsevier, nanoscale chapters
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- Health Devices IPM System: Fennigkoh and Smith 1989; Wang 2010; WHO Maintenance Programme Overview
- Safety and Performance of Medical Devices: IEC 60601-1; IEC 62353
- Uncertainty of Measurements: JCGM 100 (GUM); Iadanza metrology chapters
- Quality Improvement and Clinical Engineering Programs: Iadanza quality chapters; Wang, Medical Equipment Maintenance
- Standards for Clinical Engineering: IEC 62353; NFPA 99; AAMI EQ56
- Adverse Events and Medical Device Recalls: 21 CFR Parts 7 and 803; ECRI hazards series
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- Advanced Cost Control and Efficiency: Kaplan and Porter 2011; Kaplan and Anderson 2004; Gapenski cost chapters
- Financial Decision-Making for Biomedical Engineers: Graham and Harvey 2001; Higgins; Brealey decision chapters
- Financing Biomedical Companies in Global Markets: Eiteman, Stonehill, Moffett; Makower 2010
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- Importing Medical Devices: FDA importing guidance; WCO HS classification; national registration frameworks per destination market
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- Understanding Trade Agreements and Policies: Ricardo 1817; WTO framework and the 2020 medical-goods report; Porter 1990
- Quality Control and Risk Management in the Global Supply Chain: ISO 13485; ISO 14971 with ISO 31000; OECD counterfeit reporting
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- The Biomedical Sales Landscape: Moore; Greenhalgh 2004; AdvaMed Code; Biodesign stakeholder chapters
- The Psychology of Selling: Kahneman; Tversky and Kahneman 1974; prospect theory 1979
- The 15 Essential Tactics of Persuasion and Pre-Suasion: Cialdini, Influence and Pre-Suasion; Cialdini 1975
- Advanced Tactics for Biomedical Sales Success: Rackham; Dixon and Adamson; Voss
- Leveraging Digital Tools and AI in Biomedical Sales: Brynjolfsson and McAfee; current CRM/AI industry literature
- Practical Applications in Biomedical Engineering: Biodesign; Rogers; Greenhalgh 2004
- Mastery (role-play, final project, roadmap): Ericsson 1993; Rackham's practice framework

References reviewed: August 2026. Next review: August 2027.

Part 4: BMEssentials

BMEssentials — The Four Phase Reference Lists

The BMEssentials protocols and frameworks are original works developed by the founder. They are grounded in the established science of learning, memory, attention, and expertise cited below. The protocols are the synthesis; the science is the foundation.

Phase 1: BME Diagnosis and Orientation

- The science of why biomedical engineering feels the way it does: cognitive load, working memory limits, the stages of skill acquisition, and the difference between how learning feels and what learning does.
- Sweller, J., "Cognitive load during problem solving: effects on learning," Cognitive Science, 1988
- Sweller, J., Ayres, P., Kalyuga, S., Cognitive Load Theory, Springer
- van Merriënboer, J. J. G., Sweller, J., "Cognitive load theory and complex learning: recent developments and future directions," Educational Psychology Review, 2005
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- Chi, M. T. H., Glaser, R., "Categorization and representation of physics problems by experts and novices," Cognitive Science, 1981
- Brown, P. C., Roediger, H. L., McDaniel, M. A., Make It Stick: The Science of Successful Learning, Harvard University Press

References reviewed: August 2026. Next review: August 2027.

Phase 2: A Biomedical Engineer's Mental Tools

- The science of how experts represent knowledge: chunking, mental models, dual coding, drawing-to-learn, self-explanation, and the metacognition that tells you what you actually know.
- Chase, W. G., Simon, H. A., "Perception in chess," Cognitive Psychology, 1973

- Gobet, F., Lane, P. C. R., Croker, S., Cheng, P. C.-H., Jones, G., Oliver, I., Pine, J. M., "Chunking mechanisms in human learning," Trends in Cognitive Sciences, 2001
- Johnson-Laird, P. N., Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness, Harvard University Press
- Paivio, A., Mental Representations: A Dual Coding Approach, Oxford University Press
- Mayer, R. E., Multimedia Learning, Cambridge University Press
- Fiorella, L., Mayer, R. E., "Eight ways to promote generative learning," Educational Psychology Review, 2016
- Ainsworth, S., Prain, V., Tytler, R., "Drawing to learn in science," Science, 2011
- Chi, M. T. H., Bassok, M., Lewis, M. W., Reimann, P., Glaser, R., "Self-explanations: how students study and use examples in learning to solve problems," Cognitive Science, 1989
- Nelson, T. O., Narens, L., "Metamemory: a theoretical framework and new findings," Psychology of Learning and Motivation, 1990
- Dunning, D., Johnson, K., Ehrlinger, J., Kruger, J., "Why people fail to recognize their own incompetence," Current Directions in Psychological Science, 2003
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- Novak, J. D., Cañas, A. J., "The theory underlying concept maps and how to construct and use them," Institute for Human and Machine Cognition, technical report (open access)

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Phase 3: BME Execution Blueprints

- The science the protocols operationalize: deliberate practice, retrieval practice, spacing, interleaving, interference, the forgetting curve, and the rhythm of focused work.
- Ericsson, K. A., Krampe, R. T., Tesch-Römer, C., "The role of deliberate practice in the acquisition of expert performance," Psychological Review, 1993
- Ericsson, K. A., Pool, R., Peak: Secrets from the New Science of Expertise, Houghton Mifflin Harcourt
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- Kleitman, N., Sleep and Wakefulness, University of Chicago Press
- Dweck, C. S., Mindset: The New Psychology of Success, Random House
- Walker, M., Why We Sleep: Unlocking the Power of Sleep and Dreams, Scribner

Phase 4: A Biomedical Engineer's Career Mastery Playbook

- The science of expertise development over years, vocational fit, career transitions, and how competence is demonstrated and recognized.
- Ericsson, K. A., Krampe, R. T., Tesch-Römer, C., "The role of deliberate practice in the acquisition of expert performance," *Psychological Review*, 1993
- Simon, H. A., Chase, W. G., "Skill in chess," *American Scientist*, 1973
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- Ibarra, H., *Working Identity: Unconventional Strategies for Reinventing Your Career*, Harvard Business Review Press
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- Weiner, B., "An attributional theory of achievement motivation and emotion," *Psychological Review*, 1985
- Newport, C., *So Good They Can't Ignore You: Why Skills Trump Passion in the Quest for Work You Love*, Grand Central Publishing
- WHO, *Human Resources for Medical Devices: The Role of Biomedical Engineers*, WHO Medical Devices Technical Series, 2017 (open access)

BMEssentials — Per-Lecture References (lectures 1-31)

Lecture 1: Why Does Biomedical Engineering Feel So Much Harder Than It Is

REFERENCES

- Sweller, J., "Cognitive load during problem solving: effects on learning," *Cognitive Science*, 1988
- Sweller, J., Ayres, P., Kalyuga, S., *Cognitive Load Theory*, Springer
- van Merriënboer, J. J. G., Sweller, J., "Cognitive load theory and complex learning: recent developments and future directions," *Educational Psychology Review*, 2005
- Paas, F., Renkl, A., Sweller, J., "Cognitive load theory and instructional design: recent developments," *Educational Psychologist*, 2003

Lecture 2: The Learning Phase Biomedical Engineers Are Never Warned About

REFERENCES

- Fitts, P. M., Posner, M. I., Human Performance, Brooks/Cole, 1967
- Anderson, J. R., "Acquisition of cognitive skill," Psychological Review, 1982
- Alexander, P. A., "The development of expertise: the journey from acclimation to proficiency," Educational Researcher, 2003
- Soderstrom, N. C., Bjork, R. A., "Learning versus performance: an integrative review," Perspectives on Psychological Science, 2015

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Lecture 3: Why Biomedical Engineering Feels So Hard Even for Smart Students

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- Sweller, J., "Cognitive load during problem solving: effects on learning," Cognitive Science, 1988
- van Merriënboer, J. J. G., Sweller, J., "Cognitive load theory and complex learning: recent developments and future directions," Educational Psychology Review, 2005
- Pollock, E., Chandler, P., Sweller, J., "Assimilating complex information," Learning and Instruction, 2002
- Cowan, N., "The magical number 4 in short-term memory: a reconsideration of mental storage capacity," Behavioral and Brain Sciences, 2001

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Lecture 4: Why Biomedical Engineering Feels Harder the More You Understand It

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- Kalyuga, S., Ayres, P., Chandler, P., Sweller, J., "The expertise reversal effect," Educational Psychologist, 2003
- Alexander, P. A., "The development of expertise: the journey from acclimation to proficiency," Educational Researcher, 2003
- Kruger, J., Dunning, D., "Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessments," Journal of Personality and Social Psychology, 1999
- Soderstrom, N. C., Bjork, R. A., "Learning versus performance: an integrative review," Perspectives on Psychological Science, 2015

References reviewed: August 2026. Next review: August 2027.

Lecture 5: The Cost of Holding Biology, Physics, and Devices in One Mental Space

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- Miller, G. A., "The magical number seven, plus or minus two: some limits on our capacity for processing information," Psychological Review, 1956
- Cowan, N., "The magical number 4 in short-term memory: a reconsideration of mental storage capacity," Behavioral and Brain Sciences, 2001
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- Monsell, S., "Task switching," Trends in Cognitive Sciences, 2003

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Lecture 6: Why Early Confusion Is a Sign of Correct Learning in Biomedical Engineering

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- Kapur, M., "Productive failure," Cognition and Instruction, 2008
- D'Mello, S., Lehman, B., Pekrun, R., Graesser, A., "Confusion can be beneficial for learning," Learning and Instruction, 2014
- Soderstrom, N. C., Bjork, R. A., "Learning versus performance: an integrative review," Perspectives on Psychological Science, 2015

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Lecture 7: The Structural Difference Between Effort and Progress in BME

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- Ericsson, K. A., Krampe, R. T., Tesch-Römer, C., "The role of deliberate practice in the acquisition of expert performance," Psychological Review, 1993
- Kornell, N., Bjork, R. A., "Learning concepts and categories: is spacing the 'enemy of induction'?", Psychological Science, 2008
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., Willingham, D. T., "Improving students' learning with effective learning techniques: promising directions from cognitive and educational psychology," Psychological Science in the Public Interest, 2013

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Lecture 8: Builder vs Operator: The Cognitive Roles Inside Biomedical Engineering

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- Anderson, J. R., "Acquisition of cognitive skill," Psychological Review, 1982
- Ryle, G., The Concept of Mind, Hutchinson, 1949
- Rasmussen, J., "Skills, rules, and knowledge; signals, signs, and symbols, and other distinctions in human performance models," IEEE Transactions on Systems, Man, and Cybernetics, 1983
- Chi, M. T. H., Feltovich, P. J., Glaser, R., "Categorization and representation of physics problems by experts and novices," Cognitive Science, 1981

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Lecture 9: Concept Acquisition vs System Integration in Biomedical Engineering

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- Chi, M. T. H., Feltovich, P. J., Glaser, R., "Categorization and representation of physics problems by experts and novices," Cognitive Science, 1981
- Gobet, F., Lane, P. C. R., Croker, S., Cheng, P. C.-H., Jones, G., Oliver, I., Pine, J. M., "Chunking mechanisms in human learning," Trends in Cognitive Sciences, 2001
- Bransford, J. D., Brown, A. L., Cocking, R. R. (eds.), How People Learn: Brain, Mind, Experience, and School, National Academies Press
- Johnson-Laird, P. N., Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness, Harvard University Press

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Lecture 10: Why Studying More Often Does Not Mean Learning More in BME

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- Callender, A. A., McDaniel, M. A., "The limited benefits of rereading educational texts," Contemporary Educational Psychology, 2009
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., Willingham, D. T., "Improving students' learning with effective learning techniques: promising directions from cognitive and educational psychology," Psychological Science in the Public Interest, 2013
- Karpicke, J. D., Butler, A. C., Roediger, H. L., "Metacognitive strategies in student learning: do students practise retrieval when they study on their own?," Memory, 2009
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Lecture 11: The Fragmentation Effect Created by Semester-Based Biomedical Curricula

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- Bahrick, H. P., "Semantic memory content in permastore: fifty years of memory for Spanish learned in school," Journal of Experimental Psychology: General, 1984
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Lecture 12: When to Start from Physiology and When to Start from the Device

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- Mayer, R. E., "Models for understanding," Review of Educational Research, 1989
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- Johnson-Laird, P. N., Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness, Harvard University Press

References reviewed: August 2026. Next review: August 2027.

Lecture 13: The Exact 90-Minute Study Structure That Works for Biomedical Engineering

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- Kleitman, N., Sleep and Wakefulness, University of Chicago Press
- Ericsson, K. A., Krampe, R. T., Tesch-Römer, C., "The role of deliberate practice in the acquisition of expert performance," Psychological Review, 1993
- Trougakos, J. P., Beal, D. J., Green, S. G., Weiss, H. M., "Making the break count: an episodic examination of recovery activities, emotional experiences, and positive affective displays," Academy of Management Journal, 2008

- Ariga, A., Lleras, A., "Brief and rare mental 'breaks' keep you focused: deactivation and reactivation of task goals preempt vigilance decrements," Cognition, 2011

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Lecture 14: A Seven-Day Plan to Reach Functional Understanding of Any Medical Device

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- Karpicke, J. D., Roediger, H. L., "The critical importance of retrieval for learning," Science, 2008
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Lecture 15: The Exact Protocol for Learning 3+ Systems Simultaneously Without Collision

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- Rohrer, D., Taylor, K., "The shuffling of mathematics problems improves learning," Instructional Science, 2007
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- Monsell, S., "Task switching," Trends in Cognitive Sciences, 2003
- Cepeda, N. J., et al., "Distributed practice in verbal recall tasks," Psychological Bulletin, 2006

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Lecture 16: The Content Triage Protocol: How to Study Half and Keep 90% of the Results

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- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., Willingham, D. T., "Improving students' learning with effective learning techniques: promising directions from cognitive and educational psychology," Psychological Science in the Public Interest, 2013
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- Pashler, H., et al., Organizing Instruction and Study to Improve Student Learning, Institute of Education Sciences Practice Guide, 2007

- Bjork, E. L., Bjork, R. A., "Making things hard on yourself, but in a good way: creating desirable difficulties to enhance learning," in Psychology and the Real World, Worth Publishers, 2011
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Lecture 17: The Weekly Routine That Separates Elite Engineers From Average Ones

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- Duckworth, A. L., Peterson, C., Matthews, M. D., Kelly, D. R., "Grit: perseverance and passion for long-term goals," Journal of Personality and Social Psychology, 2007

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Lecture 18: The Biomedical Career Path Diagnostic

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- Super, D. E., "A life-span, life-space approach to career development," Journal of Vocational Behavior, 1980
- WHO, Human Resources for Medical Devices: The Role of Biomedical Engineers, WHO Medical Devices Technical Series, 2017
- Ibarra, H., Working Identity: Unconventional Strategies for Reinventing Your Career, Harvard Business Review Press

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Lecture 19: The Five Career Traps That Quietly Kill Biomedical Engineering Careers

REFERENCES

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- Arkes, H. R., Blumer, C., "The psychology of sunk cost," Organizational Behavior and Human Decision Processes, 1985
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Lecture 20: The Exact 1-Year Biomedical Skill Stack

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- Fitts, P. M., Posner, M. I., Human Performance, Brooks/Cole, 1967
- Ericsson, K. A., Pool, R., Peak: Secrets from the New Science of Expertise, Houghton Mifflin Harcourt
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- Newport, C., So Good They Can't Ignore You, Grand Central Publishing
- WHO, Human Resources for Medical Devices: The Role of Biomedical Engineers, WHO Medical Devices Technical Series, 2017

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Lecture 21: How to Know When a Topic Is Integrated Enough to Move On

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Lecture 24: How to Replace Notes With Diagrams for Faster and Deeper Understanding

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Lecture 25: The Exam Compression Protocol That Preserves Long-Term Structure

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Lecture 26: The Exact 5-Year Biomedical Skill Stack

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Lecture 27: How to Turn a Major Exam Failure Into a Permanent Rebuild in 14 Days

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Lecture 28: How to Prove You Understand a System Using a Single Drawing

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Lecture 29: Stuck in a Bad Course or Useless Training: The Protocol That Extracts Real Knowledge From Mandatory Material

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Lecture 30: The Interview Protocol: How to Prove BME Competence in 30 Minutes

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Lecture 31: From Student to Hired: The Exact 6-Month Path to Landing Your First BME Role

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References reviewed: August 2026. Next review: August 2027.

Part 5: BMEssence Guides

Section 1 of 5: RESOLVE Troubleshooting Series (69 manuals)

Each RESOLVE manual inherits the complete reference block of its device in the Device Library: the device's own particular standard, founding papers, quality-control sources, and clinical-use standards. The references below govern the troubleshooting methodology, maintenance science, failure analysis, and safety framework shared across all 69 manuals. Together, the two layers back every manual in the series.

STANDARDS AND REGULATORY FRAMEWORK

- IEC 62353, Medical Electrical Equipment: Recurrent Test and Test After Repair of Medical Electrical Equipment
- IEC 60601-1, Medical Electrical Equipment: General Requirements for Basic Safety and Essential Performance
- IEC 60601-1-8, Alarm Systems in Medical Electrical Equipment and Medical Electrical Systems
- IEC 60601-1-2, Electromagnetic Disturbances: Requirements and Tests
- IEC 60601-1-6 and IEC 62366-1, Usability Engineering for Medical Devices
- ISO 14971, Application of Risk Management to Medical Devices, with ISO/TR 24971 guidance
- ISO 13485, Quality Management Systems for Medical Devices
- IEC 60812, Failure Modes and Effects Analysis
- IEC 61025, Fault Tree Analysis
- IEC 80001-1, Application of Risk Management for IT-Networks Incorporating Medical Devices
- ANSI/AAMI EQ56, Recommended Practice for a Medical Equipment Management Program
- ANSI/AAMI EQ89, Guidance for the Use of Medical Equipment Maintenance Strategies and Procedures
- NFPA 99, Health Care Facilities Code
- U.S. FDA, 21 CFR Part 803, Medical Device Reporting, and the MAUDE adverse-event database
- Joint Commission, Environment of Care standards, medical equipment management

CORE TEXTS

- Iadanza, E. (ed.), Clinical Engineering Handbook, Elsevier
- Dyro, J. F. (ed.), Clinical Engineering Handbook, Academic Press
- Carr, J. J., Brown, J. M., Introduction to Biomedical Equipment Technology, Pearson
- Khandpur, R. S., Handbook of Biomedical Instrumentation, McGraw Hill
- Webster, J. G. (ed.), Medical Instrumentation: Application and Design, Wiley
- Wang, B., Medical Equipment Maintenance: Management and Oversight, Morgan and Claypool
- Fries, R. C., Reliable Design of Medical Devices, CRC Press
- O'Connor, P. D. T., Kleyner, A., Practical Reliability Engineering, Wiley
- Moubray, J., Reliability-Centered Maintenance, Industrial Press
- Reason, J., Human Error, Cambridge University Press
- Dekker, S., The Field Guide to Understanding 'Human Error', CRC Press

- Leveson, N. G., *Engineering a Safer World: Systems Thinking Applied to Safety*, MIT Press
- Vincent, C., *Patient Safety*, Wiley-Blackwell

LANDMARK PAPERS AND GUIDANCE

- Nowlan, F. S., Heap, H. F., *Reliability-Centered Maintenance*, U.S. Department of Defense report, 1978
- Fennigkoh, L., Smith, B., "Clinical equipment management," JCAHO Plant, Technology and Safety Management Series, 1989
- Ridgway, M., "Classifying medical devices according to their maintenance sensitivity: a practical, risk-based approach to PM program management," *Biomedical Instrumentation and Technology*, 2009
- Wang, B., et al., "Evidence-based maintenance: part I, measuring maintenance effectiveness with failure codes," *Journal of Clinical Engineering*, 2010
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- Leveson, N. G., Turner, C. S., "An investigation of the Therac-25 accidents," *IEEE Computer*, 1993
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- Cooper, J. B., Newbower, R. S., Long, C. D., McPeck, B., "Preventable anesthesia mishaps: a study of human factors," *Anesthesiology*, 1978
- Kohn, L. T., Corrigan, J. M., Donaldson, M. S. (eds.), *To Err Is Human: Building a Safer Health System*, Institute of Medicine, 2000
- WHO, *Medical Equipment Maintenance Programme Overview*, WHO Medical Devices Technical Series, 2011 (open access)
- WHO, *Computerized Maintenance Management System*, WHO Medical Devices Technical Series, 2011 (open access)
- WHO, *Introduction to Medical Equipment Inventory Management*, WHO Medical Devices Technical Series, 2011 (open access)
- ECRI, *Top 10 Health Technology Hazards (annual series) and Health Devices evaluations*
- AAMI Foundation, *Clinical Alarms 2011 Summit report*

References reviewed: August 2026. Next review: August 2027.

Section 2 of 5: Device Intelligence Series (69 guides)

Each Device Intelligence guide inherits the complete reference block of its device in the Device Library: the device's own particular standard, founding papers, quality-control sources, clinical-use standards, and recency anchors. The references below govern the shared foundations of the series: the engineering, physics, physiology, clinical, regulatory, and economic frameworks through which every device is analyzed. Together, the two layers back every guide in the series.

STANDARDS AND REGULATORY FRAMEWORK

- IEC 60601-1, Medical Electrical Equipment: General Requirements for Basic Safety and Essential Performance
- IEC 60601-1-2, Electromagnetic Disturbances; IEC 60601-1-6, Usability; IEC 60601-1-8, Alarm Systems
- ISO 14971, Application of Risk Management to Medical Devices
- ISO 13485, Quality Management Systems for Medical Devices
- ISO 10993 series, Biological Evaluation of Medical Devices
- IEC 62304, Medical Device Software Life Cycle Processes
- IEC 62366-1, Application of Usability Engineering to Medical Devices
- EU Regulation 2017/745 (MDR), including classification rules (Annex VIII) and post-market surveillance requirements
- U.S. FDA, 21 CFR Part 860 (device classification), Part 807 (510(k)), Part 814 (PMA), Part 803
- IMDRF, Principles of Medical Devices Classification
- WHO, Global Model Regulatory Framework for Medical Devices Including In Vitro Diagnostic Medical Devices, 2017 (open access)
- ICRP Publication 103 and IAEA SSG-46
- GMDN (Global Medical Device Nomenclature) and UDI (Unique Device Identification) frameworks

CORE TEXTS

- Webster, J. G. (ed.), Encyclopedia of Medical Devices and Instrumentation, Wiley
- Kramme, R., Hoffmann, K.-P., Pozos, R. S. (eds.), Springer Handbook of Medical Technology, Springer
- Bronzino, J. D. (ed.), The Biomedical Engineering Handbook, CRC Press, and Medical Devices and Systems, CRC Press
- Webster, J. G. (ed.), Medical Instrumentation: Application and Design, Wiley
- Bushberg, J. T., et al., The Essential Physics of Medical Imaging, Wolters Kluwer
- Hall, J. E., Guyton and Hall Textbook of Medical Physiology, Elsevier
- Ratner, B. D., et al. (eds.), Biomaterials Science: An Introduction to Materials in Medicine, Elsevier
- Iadanza, E. (ed.), Clinical Engineering Handbook, Elsevier
- Khandpur, R. S., Handbook of Biomedical Instrumentation, McGraw Hill
- Carr, J. J., Brown, J. M., Introduction to Biomedical Equipment Technology, Pearson
- Yock, P., Zenios, S., Makower, J., et al., Biodesign: The Process of Innovating Medical Technologies, Cambridge University Press
- Ogrodnik, P. J., Medical Device Design: Innovation from Concept to Market, Elsevier
- Ramakrishna, S., et al., Medical Devices: Regulations, Standards and Practices, Woodhead Publishing / Elsevier
- Beauchamp, T. L., Childress, J. F., Principles of Biomedical Ethics, Oxford University Press

LANDMARK PAPERS AND GUIDANCE

- Greatbatch, W., Holmes, C. F., "History of implantable devices," IEEE Engineering in Medicine and Biology Magazine, 1991
- Nebeker, F., "Golden accomplishments in biomedical engineering," IEEE Engineering in Medicine and Biology Magazine, 2002

- Kaplan, A. V., et al., "Medical device development: from prototype to regulatory approval," Circulation, 2004
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- Resnic, F. S., Normand, S.-L. T., "Postmarketing surveillance of medical devices: filling in the gaps," New England Journal of Medicine, 2012
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- Cohen, D., "How safe are metal-on-metal hip implants?," BMJ, 2012
- Sjoding, M. W., et al., "Racial bias in pulse oximetry measurement," New England Journal of Medicine, 2020
- Greenhalgh, T., et al., "Diffusion of innovations in service organizations: systematic review and recommendations," Milbank Quarterly, 2004
- Drummond, M. F., et al., Methods for the Economic Evaluation of Health Care Programmes, Oxford University Press
- WHO, Health Technology Assessment of Medical Devices, WHO Medical Devices Technical Series (open access)
- WHO, Procurement Process Resource Guide and Medical Device Donations: Considerations for Solicitation and Provision, WHO Medical Devices Technical Series
- WHO, Medical Devices: Managing the Mismatch, 2010
- ECRI, Top 10 Health Technology Hazards (annual series) and Health Devices comparative evaluations
- ACR Appropriateness Criteria
- Cochrane Database of Systematic Reviews, device-therapy reviews

References reviewed: August 2026. Next review: August 2027.

Section 3 of 5: BMEssentials Cognitive Intelligence Series (31 guides)

Each Cognitive Intelligence guide inherits the reference block of its corresponding BMEssentials lecture and the foundation list of its phase. The protocols and frameworks are original works of the founder. The references below govern the shared scientific foundation of the series: the cognitive science, neuroscience, and educational psychology of how humans learn, remember, focus, and become experts. Together, the two layers back every guide in the series.

FOUNDATIONAL SCIENCE OF LEARNING AND MEMORY

- Hebb, D. O., The Organization of Behavior: A Neuropsychological Theory, Wiley, 1949
- Bliss, T. V. P., Lømo, T., "Long-lasting potentiation of synaptic transmission in the dentate area of the anaesthetized rabbit," Journal of Physiology, 1973
- Kandel, E. R., "The molecular biology of memory storage: a dialogue between genes and synapses," Science, 2001

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- Bjork, R. A., Bjork, E. L., "A new theory of disuse and an old theory of stimulus fluctuation," in *From Learning Processes to Cognitive Processes*, Erlbaum, 1992
- Stickgold, R., "Sleep-dependent memory consolidation," *Nature*, 2005
- Walker, M. P., Stickgold, R., "Sleep, memory, and plasticity," *Annual Review of Psychology*, 2006

COGNITIVE LOAD, EXPERTISE, AND REPRESENTATION

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- Fitts, P. M., Posner, M. I., *Human Performance*, Brooks/Cole, 1967
- Anderson, J. R., "Acquisition of cognitive skill," *Psychological Review*, 1982
- Paivio, A., *Mental Representations: A Dual Coding Approach*, Oxford University Press
- Mayer, R. E., *Multimedia Learning*, Cambridge University Press
- Ainsworth, S., Prain, V., Tytler, R., "Drawing to learn in science," *Science*, 2011

LEARNING STRATEGIES, METACOGNITION, AND MOTIVATION

- Roediger, H. L., Karpicke, J. D., "Test-enhanced learning: taking memory tests improves long-term retention," *Psychological Science*, 2006
- Karpicke, J. D., Roediger, H. L., "The critical importance of retrieval for learning," *Science*, 2008
- Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., Rohrer, D., "Distributed practice in verbal recall tasks: a review and quantitative synthesis," *Psychological Bulletin*, 2006
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- Soderstrom, N. C., Bjork, R. A., "Learning versus performance: an integrative review," *Perspectives on Psychological Science*, 2015

- Rohrer, D., Taylor, K., "The shuffling of mathematics problems improves learning," *Instructional Science*, 2007
- Chi, M. T. H., Bassok, M., Lewis, M. W., Reimann, P., Glaser, R., "Self-explanations: how students study and use examples in learning to solve problems," *Cognitive Science*, 1989
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- Nelson, T. O., Narens, L., "Metamemory: a theoretical framework and new findings," *Psychology of Learning and Motivation*, 1990
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- Metcalfe, J., "Learning from errors," *Annual Review of Psychology*, 2017

SYNTHESIS TEXTS AND INSTITUTIONAL GUIDANCE

- Bransford, J. D., Brown, A. L., Cocking, R. R. (eds.), *How People Learn: Brain, Mind, Experience, and School*, National Academies Press (open access)
- National Academies of Sciences, Engineering, and Medicine, *How People Learn II: Learners, Contexts, and Cultures*, National Academies Press, 2018 (open access)
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- Oakley, B., *A Mind for Numbers: How to Excel at Math and Science (Even If You Flunked Algebra)*, TarcherPerigee
- Willingham, D. T., *Why Don't Students Like School?*, Jossey-Bass
- Pashler, H., et al., *Organizing Instruction and Study to Improve Student Learning*, Institute of Education Sciences Practice Guide, 2007 (open access)
- Deans for Impact, *The Science of Learning*, 2015 (open access)

References reviewed: August 2026. Next review: August 2027.

Section 4 of 5: Career Architecture Series (31 guides) — FINAL

The Career Architecture guides are original frameworks developed by the founder for building a biomedical engineering career. The references below govern the shared foundation of the series: the science of expertise and skill development, vocational and organizational psychology, the research on how careers are actually built and jobs actually found, and the documented landscape of the biomedical engineering profession.

THE PROFESSION AND ITS FRAMEWORKS

- WHO, Human Resources for Medical Devices: The Role of Biomedical Engineers, WHO Medical Devices Technical Series, 2017
- WHO, Global Atlas of Medical Devices, WHO
- ABET, Criteria for Accrediting Engineering Programs, biomedical engineering program criteria
- ACCE, Clinical Engineering Certification (CCE) Body of Knowledge, American College of Clinical Engineering
- AAMI, Certified Biomedical Equipment Technician (CBET) and Certified Healthcare Technology Manager (CHTM) frameworks
- IFMBE, International Federation for Medical and Biological Engineering, professional and educational resources
- BMES, Biomedical Engineering Society, career and professional development resources
- Madhavan, G., Oakley, B., Kun, L. (eds.), Career Development in Bioengineering and Biotechnology, Springer
- National Academy of Engineering, The Engineer of 2020: Visions of Engineering in the New Century, National Academies Press (open access)
- Nebeker, F., "Golden accomplishments in biomedical engineering," IEEE Engineering in Medicine and Biology Magazine, 2002

EXPERTISE, SKILL DEVELOPMENT, AND DELIBERATE PRACTICE

- Ericsson, K. A., Krampe, R. T., Tesch-Römer, C., "The role of deliberate practice in the acquisition of expert performance," Psychological Review, 1993
- Simon, H. A., Chase, W. G., "Skill in chess," American Scientist, 1973
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- Fitts, P. M., Posner, M. I., Human Performance, Brooks/Cole, 1967
- Bloom, B. S. (ed.), Developing Talent in Young People, Ballantine Books, 1985
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VOCATIONAL PSYCHOLOGY AND CAREER DEVELOPMENT

- Holland, J. L., *Making Vocational Choices: A Theory of Vocational Personalities and Work Environments*, Psychological Assessment Resources
- Super, D. E., "A life-span, life-space approach to career development," *Journal of Vocational Behavior*, 1980
- Savickas, M. L., "Career construction theory and practice," in Brown, S. D., Lent, R. W. (eds.), *Career Development and Counseling: Putting Theory and Research to Work*, Wiley
- Lent, R. W., Brown, S. D., Hackett, G., "Toward a unifying social cognitive theory of career and academic interest, choice, and performance," *Journal of Vocational Behavior*, 1994
- Ibarra, H., *Working Identity: Unconventional Strategies for Reinventing Your Career*, Harvard Business Review Press
- Ibarra, H., "Provisional selves: experimenting with image and identity in professional adaptation," *Administrative Science Quarterly*, 1999
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- Hall, D. T., "The protean career: a quarter-century journey," *Journal of Vocational Behavior*, 2004
- Newport, C., *So Good They Can't Ignore You: Why Skills Trump Passion in the Quest for Work You Love*, Grand Central Publishing
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JOB SEARCH, SELECTION, AND PROFESSIONAL NETWORKS

- Granovetter, M. S., "The strength of weak ties," *American Journal of Sociology*, 1973
- Granovetter, M. S., *Getting a Job: A Study of Contacts and Careers*, University of Chicago Press
- Burt, R. S., *Structural Holes: The Social Structure of Competition*, Harvard University Press
- Schmidt, F. L., Hunter, J. E., "The validity and utility of selection methods in personnel psychology: practical and theoretical implications of 85 years of research findings," *Psychological Bulletin*, 1998
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- Kram, K. E., *Mentoring at Work: Developmental Relationships in Organizational Life*, University Press of America
- Allen, T. D., et al., "Career benefits associated with mentoring for protégés: a meta-analysis," *Journal of Applied Psychology*, 2004

DECISION-MAKING, LEADERSHIP, AND PROFESSIONAL CONDUCT

- Kahneman, D., Tversky, A., "Prospect theory: an analysis of decision under risk," *Econometrica*, 1979
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- Kotter, J. P., *Leading Change*, Harvard Business Review Press
- Edmondson, A., "Psychological safety and learning behavior in work teams," *Administrative Science Quarterly*, 1999

- Fisher, R., Ury, W., Patton, B., Getting to Yes: Negotiating Agreement Without Giving In, Penguin
- National Society of Professional Engineers, Code of Ethics for Engineers (open access)
- IEEE, Code of Ethics (open access)
- Beauchamp, T. L., Childress, J. F., Principles of Biomedical Ethics, Oxford University Press

References reviewed: August 2026. Next review: August 2027.

Section 5 of 5: Business Mastery Series (31 guides) — FINAL

The Business Mastery guides are original frameworks developed by the founder for the commercial side of biomedical engineering. The references below govern the shared foundation of the series: corporate finance and valuation, strategy and marketing, medtech commercialization and regulatory economics, sales and negotiation, operations and supply chain, entrepreneurship, and the ethics and compliance frameworks every medical device business operates under.

FINANCE, VALUATION, AND ECONOMICS

- Brealey, R. A., Myers, S. C., Allen, F., Principles of Corporate Finance, McGraw Hill
- Berk, J., DeMarzo, P., Corporate Finance, Pearson
- Higgins, R. C., Analysis for Financial Management, McGraw Hill
- Gapenski, L. C., Reiter, K. L., Healthcare Finance: An Introduction to Accounting and Financial Management, Health Administration Press
- Damodaran, A., Investment Valuation: Tools and Techniques for Determining the Value of Any Asset, Wiley
- Koller, T., Goedhart, M., Wessels, D., Valuation: Measuring and Managing the Value of Companies, McKinsey and Company / Wiley
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- Modigliani, F., Miller, M. H., "The cost of capital, corporation finance and the theory of investment," American Economic Review, 1958
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STRATEGY, MARKETING, AND MARKET ACCESS

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- Porter, M. E., Teisberg, E. O., Redefining Health Care: Creating Value-Based Competition on Results, Harvard Business Review Press
- Christensen, C. M., The Innovator's Dilemma, Harvard Business Review Press
- Christensen, C. M., Grossman, J. H., Hwang, J., The Innovator's Prescription: A Disruptive Solution for Health Care, McGraw Hill
- Moore, G. A., Crossing the Chasm: Marketing and Selling Disruptive Products to Mainstream Customers, Harper Business
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- Kim, W. C., Mauborgne, R., Blue Ocean Strategy, Harvard Business Review Press

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- Yock, P., Zenios, S., Makower, J., et al., Biodesign: The Process of Innovating Medical Technologies, Cambridge University Press
- Makower, J., Meer, A., Denend, L., FDA Impact on U.S. Medical Technology Innovation, 2010
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- Sorenson, C., Drummond, M., "Improving medical device regulation: the United States and Europe in perspective," Milbank Quarterly, 2014

SALES, NEGOTIATION, AND CUSTOMER UNDERSTANDING

- Rackham, N., SPIN Selling, McGraw Hill
- Dixon, M., Adamson, B., The Challenger Sale: Taking Control of the Customer Conversation, Portfolio
- Cialdini, R. B., Influence: The Psychology of Persuasion, Harper Business
- Fisher, R., Ury, W., Patton, B., Getting to Yes: Negotiating Agreement Without Giving In, Penguin
- Kahneman, D., Thinking, Fast and Slow, Farrar, Straus and Giroux
- Tversky, A., Kahneman, D., "Judgment under uncertainty: heuristics and biases," Science, 1974

ENTREPRENEURSHIP, OPERATIONS, AND SUPPLY CHAIN

- Ries, E., The Lean Startup, Crown Business
- Blank, S., Dorf, B., The Startup Owner's Manual, Wiley
- Osterwalder, A., Pigneur, Y., Business Model Generation, Wiley
- Feld, B., Mendelson, J., Venture Deals: Be Smarter Than Your Lawyer and Venture Capitalist, Wiley
- Metrick, A., Yasuda, A., Venture Capital and the Finance of Innovation, Wiley
- Gompers, P., Gornall, W., Kaplan, S. N., Strebulaev, I. A., "How do venture capitalists make decisions?," Journal of Financial Economics, 2020
- Christopher, M., Logistics and Supply Chain Management, Pearson

- Womack, J. P., Jones, D. T., Lean Thinking: Banish Waste and Create Wealth in Your Corporation, Free Press
- International Chamber of Commerce, Incoterms 2020, ICC Publication
- WTO, Trade in Medical Goods in the Context of Tackling COVID-19, 2020 (open access)

ETHICS, COMPLIANCE, AND GOVERNANCE

- AdvaMed, Code of Ethics on Interactions with Health Care Professionals (open access)
- MedTech Europe, Code of Ethical Business Practice (open access)
- U.S. Physician Payments Sunshine Act framework, 42 CFR Parts 402-403
- Jensen, M. C., Meckling, W. H., "Theory of the firm: managerial behavior, agency costs and ownership structure," Journal of Financial Economics, 1976
- Beauchamp, T. L., Childress, J. F., Principles of Biomedical Ethics, Oxford University Press

References reviewed: August 2026. Next review: August 2027.

Editorial Standards

How BMEssentia content is created, sourced, and maintained

Our commitment

Every course, device breakdown, guide, and practice question on BMEssentia exists to be trusted by students, engineers, and the institutions that teach them. That trust is earned through a documented editorial process, not assumed.

How content is created

All content on BMEssentia is built from the field's established canon: the standard textbooks taught in accredited biomedical engineering programs worldwide, international standards from the IEC, ISO, and related bodies, and the primary and review literature of the field. Content is written in original language for clarity and cognitive accessibility; it paraphrases and teaches from the canon, it does not reproduce it.

How sources are selected

Each course and device carries a reference block built in tiers. Core Texts are the textbooks an accredited program would itself assign. Standards and Regulatory entries are the operative international standards for the topic or device class. Landmark Papers are the primary literature that established the science. Current Reviews keep each topic anchored to the present state of the field. Sources are selected for authority, verifiability, and accessibility, with open-access materials flagged wherever available. All references are English-language publications.

Illustrations and practice questions

All 3,800+ illustrations are original works created by BMEssentia, drawn to teach the concepts documented in each topic's reference sources. Each illustration's accompanying description is anchored in the reference sources of its parent course or device. All practice questions are derived from the same sources as their parent course or device.

Safety-critical content

Content describing the operation, failure, or servicing of real medical devices is held to a stricter bar: no invented values, universal physical constants only, and any procedure touching hardware, high voltage, pressurized or blood-contacting circuits, or pharmaceuticals routes to escalation rather than field improvisation. Manufacturer- and model-specific material is declared out of scope and directed to the reader's own site documentation.

Review cadence

Every reference block carries its last review date and next scheduled review. The full reference library is reviewed annually; standards entries are additionally checked against the issuing body's current catalog at each review.

Corrections

Errors reported by users, educators, or institutional partners are logged, verified against the reference sources, and corrected. Substantive corrections are reflected in the affected content's next review date.

Scope of claims

BMEssentia aligns its course scope with ABET biomedical engineering program criteria and IFMBE curriculum guidance. BMEssentia is an independent educational platform; alignment does not imply accreditation, endorsement, or certification by any standards body or accreditor.