

Fundamentals Content and Assessment Outline

Domains	Description	Module Content %	Summative Assessment %	Resources and References
Principles of Ultrasound Physics	1. Define the basic principles and terminology of ultrasound physics, including sound, wave characteristics, and ultrasound machine basics. 2. Describe the physics of sound as it relates to wave motion, propagation, and image formation in diagnostic ultrasound. 3. Identify common calculations of sound used in ultrasound, including but not limited to pulse repetition frequency, pulse repetition period, and distance. 4. Describe how pulse repetition frequency and pulse repetition period relate to ultrasound imaging. 5. Explain the effect of different media on sound propagation.	14%	14%	• Edelman, S.K. (2007). Understanding Ultrasound Physics, 3rd. Ed. ESP, Inc. Woodlands, Texas. Hedrick, W. & Wagner, P. (2013). Technology for Diagnostic Sonography: Study Guide and Laboratory Exercises. Elsevier Mosby: St. Louis, Missouri. • Gill, K.A. (2001). Abdominal Ultrasound: A Practitioner's Guide. W.B. Saunders Company: Philadelphia, Pennsylvania. • Hagen-Ansert, S. (2006). Textbook of Diagnostic Ultrasonography, 6th edition. Mosby: Saint Louis.
Echogenicity & Attenuation	1. Define echogenicity and describe common differences in tissue appearance on ultrasound images. 2. Distinguish between homogeneous and heterogeneous tissue patterns on ultrasound. 3. Describe propagation speed, intensity, power, and amplitude of sound. 4. Explain how normal incidence affects ultrasonic signal reflection. 5. Describe attenuation of sound waves and identify the main types of attenuation. 6. Describe the variables that affect the echogenicity of tissues and structures and the attenuation of ultrasonic signals.	13%	14%	• Hagen-Ansert, S. (2006). Textbook of Diagnostic Ultrasonography, 6th edition. Mosby: Saint Louis.
Machine Modes	1. Identify the major ultrasound modes used in point-of-care ultrasound. 2. Describe the purpose of B-mode, M-mode, A-Mode, Elastography, color Doppler, power Doppler, and other Doppler types. 3. Explain the fundamental differences between Doppler ultrasound and B-mode ultrasound. 4. Describe the type of information provided by each ultrasound mode. 5. Understand Doppler angle correction for accurate velocity measurement.	14%	14%	• Hagen-Ansert, S. (2006). Textbook of Diagnostic Ultrasonography, 6th edition. Mosby: Saint Louis. • Gurun, E., Ozturk, M., Basaran, M., & Okutan, A. E. (2026). Shear Wave Elastography in Musculoskeletal Imaging: A Narrative Review. Journal of Clinical Medicine, 15(12), 4843. https://doi.org/10.3390/jcm15124843 • Charoenchue, P., Khorana, J., Chitapanarux, T., Inmutto, N., Na Chiangmai, W., Amantakul, A., Pojchamarnwiputh, S., & Tantraworasin, A. (2024). Two-Dimensional Shear-Wave Elastography: Accuracy in Liver Fibrosis Staging Using Magnetic Resonance Elastography as the Reference Standard. Diagnostics (Basel, Switzerland), 15(1), 62. https://doi.org/10.3390/diagnostics15010062 • Sigrist, R.M.S., Liau, J., Kaffas, A.E., Chammass, M.C., Willmann, J.K. (2017). Ultrasound Elastography: Review of Techniques and Clinical Applications. Theranostics, 7(5), 1303-1329. https://doi.org/10.7150/thno.18650. • Petrella, L., Perdigão, F., Caixinha, M., Santos, M., Lopes, M., Gomes, M., & Santos, J. (2021). A-scan ultrasound in ophthalmology: A simulation tool. Medical engineering & physics, 97, 18–24. https://doi.org/10.1016/j.medengphy.2021.09.005 • Kadakia, A., Zhang, J., Yao, X., Zhou, Q., & Heiferman, M. J. (2023). Ultrasound in ocular oncology: Technical advances, clinical applications, and limitations. Experimental biology and medicine (Maywood, N.J.), 248(5), 371–379. https://doi.org/10.1177/15353702231169539 • Streho, M., Caillaux, V., Puech, M. (2026). Indications of Ultrasound A-Mode and B-Mode Biometry. In: Armia, A., Sandali, O., Tahiri, R. (eds) Cataract Surgery. Springer, Cham. https://doi.org/10.1007/978-3-031-98572-0_6

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Transducers	1. Identify common transducer types used in point-of-care ultrasound. 2. Describe the anatomy of a transducer and its role in ultrasound imaging. 3. Describe pulse bandwidth and the effect of varying frequencies on ultrasound imaging. 4. Explain factors that determine transducer selection, including body habitus, exam purpose, and acoustic windows. 5. Describe correct hand positioning and basic considerations for transducer manipulation during scanning.	13%	12%	Hedrick, W. & Wagner, P. (2013). Technology for Diagnostic Sonography: Study Guide and Laboratory Exercises. Elsevier Mosby: St. Louis, Missouri.
Orientation	1. Identify body sections and scanning planes used in ultrasound imaging. 2. Describe standard image orientations used during point-of-care ultrasound examinations. 3. Describe basic transducer manipulation techniques used to obtain ultrasound images. 4. Explain general scanning tips that support accurate image acquisition.	10%	9%	Gill, K.A. (2001). Abdominal Ultrasound: A Practitioner's Guide. W.B. Saunders Company: Philadelphia, Pennsylvania.
Ultrasound Artifacts	1. Define ultrasound artifacts and explain why they are important in image interpretation. 2. Identify common types of ultrasound artifacts. 3. Describe the causes of common ultrasound artifacts. 4. Explain how artifacts can affect ultrasound image interpretation.	13%	14%	- Hedrick, W. & Wagner, P. (2013). Technology for Diagnostic Sonography: Study Guide and Laboratory Exercises. Elsevier Mosby: St. Louis, Missouri. - American Institute of Ultrasound in Medicine. (1999). Standard Presentation and Labeling of Ultrasound Images: A Stage 2 Standard. - Curry, R.A. & Tempkin, B.B. (2004). Sonography: Introduction to Normal Structure and Function, 2nd Ed. Saunders: Philadelphia, Pennsylvania. - Erez, Y., Schechner, Y.Y., & Adams, D. (2008). Space variant ultrasound frequency compounding based on noise characteristics. Ultrasound in Med. & Biol., 34 (6), 981-1000. - Gil, K.A. (2001). Abdominal Ultrasound: A Practitioner's Guide. W.B. Saunders Company: Philadelphia, Pennsylvania. - Hagen-Ansert, S. (2006). Textbook of Diagnostic Ultrasonography, 6th edition. Mosby: Saint Louis.

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Safety and Bioeffects	- Describe key ultrasound safety concepts, including infection prevention, ALARA, bioeffects, Thermal Index (TI), and Mechanical Index (MI). - Explain how infection can be transmitted during POCUS and identify common sources of contamination, including probes, cords, gel, and machine surfaces. - Differentiate the Spaulding classification categories and describe the basic steps of probe reprocessing before and after a scan. - Explain the potential bioeffects of diagnostic ultrasound, including heat as a primary risk and the role of TI and MI in limiting exposure. - Describe safe ergonomic practices for POCUS operators and explain how they help reduce musculoskeletal strain. - Understand the emerging role of artificial intelligence in ultrasound imaging.	13%	14%	- Craig, M. (2013). Essentials of Sonography and Patient Care, 3rd Ed. Saunders: St. Louis, MO. - Ellis, J. R., & Bentz, P. M. (2007). Modules for basic nursing skills (7th ed.). Philadelphia: Lippincott Williams & Wilkins. pp. 488-491. - Hagen-Ansert, S.L. (2012). Textbook of Diagnostic Medical Sonography, 7th Ed. Elsevier: St. Louis, Missouri. - Perry, A. G., & Potter, P. A. (2006). Clinical nursing skills and techniques (6th ed.). St. Louis, MO: Elsevier Mosby. pp. 1222-1225. - American Institute of Ultrasound in Medicine. (2015). Official Statement on Prudent Use and Clinical Safety. - American Institute of Ultrasound in Medicine. (2015). Official Statement on Mammalian Biological Effects of Heat. - Edelman, S.K. (2007). Understanding Ultrasound Physics, 3rd. Ed. ESP, Inc. Woodlands, Texas. - AIUM practice principles for work-related musculoskeletal disorder. J Ultrasound Med. 2023;42(5):1139-1157. doi:10.1002/jum.16124 - Fowlkes JB, Kripfgans OD, Bagley J. Safety, ergonomics and patient centered point-of-care ultrasound. Med Clin North Am. 2025;109(1):325-341. doi:10.1016/j.mcna.2024.08.003 - Industry standards for the prevention of work-related musculoskeletal disorders in sonography. J Diagn Med Sonogr. 2017;33(5):370-391. doi:10.1177/8756479317725531 - Siegel JD, Rhinehart E, Jackson M, Chiarello L; Healthcare Infection Control Practices Advisory Committee. 2007 guideline for isolation precautions: preventing transmission of infectious agents in health care settings. Am J Infect Control. 2007;35(10 suppl 2):S65-S164. doi:10.1016/j.ajic.2007.10.007 - Rutala WA, Weber DJ. Disinfection and sterilization in health care facilities: an overview and current issues. Infect Dis Clin North Am. 2016;30(3):609-637. doi:10.1016/j.idc.2016.04.002 - American Institute of Ultrasound in Medicine. AIUM official statement: guidelines for cleaning and preparing external- and internal-use ultrasound transducers and equipment between patients as well as safe handling and use of ultrasound coupling gel, 2025 revision. J Ultrasound Med. 2025;44(12):E1-E9. doi:10.1002/jum.70014 - Carrico RM, Furmanek S, English C. Ultrasound probe use and reprocessing: results from a national survey among U.S. infection preventionists. Am J Infect Control. 2018;46(8):913-920. doi:10.1016/j.ajic.2018.03.025 - Sartoretti T, Sartoretti E, Bucher C, et al. Bacterial contamination of ultrasound probes in different radiological institutions before and after specific hygiene training: do we have a general hygienical problem? Eur Radiol. 2017;27(10):4181-4187. doi:10.1007/s00330-017-4812-1