BIOMEDICAL IMAGING EQUIPMENT TECHNICIAN (BIET)
COMPETENCY REQUIREMENTS

The BIET can be used as a 'stand-alone' ETA Certification or as the Journeyman Option specialty exam for the Certified Electronics Technician, CET.
The purpose in distributing the Competency is to provide a detailed syllabus for electronics educational institutions and instructors. Also to go further and explain what the student should be able to do with each of the items included in the Competencies listings.

Biomedical Imaging Equipment electronics technicians must be knowledgeable and have abilities in the following technical and regulatory areas:

1.0 ANATOMY
- 1.1 State the purposes of the skeletal system
- 1.2 Describe Appendicular Skeletal System
- 1.3 Describe Axial Skeletal System
- 1.4 Identify Bone versus Cartilage and differentiate between the two
- 1.5 Identify Ligament versus Tendon and explain the differences
- 1.6 Identify Major Nerves
- 1.7 Identify Major Veins
- 1.8 Identify Major Bones

2.0 MEDICAL TERMINOLOGY
- 2.1 Describe the Anatomical Position
- 2.2 State Positional Terms
- 2.3 State Directional Terms
- 2.4 Identify Anatomical Planes
- 2.5 Describe Supine and compare the term with Prone
- 2.6 Identify major suffixes, roots and prefixes used in medical terminology
- 2.7 State radiographic positional terms

3.0 COMPUTER
- 3.1 Explain how a modem interfaces with the computer
- 3.2 Demonstrate ability to install RJ45/48 connectors and fittings
- 3.3 Differentiate between single twisted pair and CAT-5, CAT-5e, CAT-6_A
- 3.4 Define network control points
- 3.5 Define database
- 3.6 Explain the command ability to "ping" hardware along the network

4.0 ELECTRO/MECHANICAL SAFETY
- 4.1 Define electrical safety
- 4.2 Relate how preventive maintenance reduces electrical hazards
- 4.3 Define corrective maintenance
- 4.4 Define scheduled maintenance
- 4.5 Explain lock out/tag out procedures
- 4.6 Define leakage current
- 4.7 Define required grounding for imaging equipment (portable and fixed)
- 4.8 Administer electrical safety tests on equipment
- 4.9 Explain universal precautions.
- 4.10 State the ground resistances for existing portable medical equipment in patient-care areas
- 4.11 State the ground resistances for new portable medical equipment in patient-care areas
- 4.12 State the chassis leakage current for portable medical equipment in patient-care areas
- 4.13 State the lead leakage current for portable medical equipment in patient-care areas
- 4.14 State the leakage current for x-ray equipment in patient-care areas

5.0 PICTURE ARCHIVE COMMUNICATION SYSTEM (PACS)

5.1 Define Picture Archive Communication System (PACS)
5.2 List major components of PACS
5.3 Explain electrical surge potentials
5.4 List ways of preventing damage from electrical surges
5.5 Describe the internet's application to imaging modalities
5.6 Explain TCP/IP duties and protocols
5.7 Describe cybersecurity problems with internet applications
5.8 Describe Tele-radiology
5.9 Describe intranet applications to imaging modalities
5.10 Explain basic computer / network maintenance procedures

6.0 DIAGNOSTIC ULTRASOUND (SONOGRAPHY) EQUIPMENT

6.1. List the functions of the five basic components of a diagnostic medical ultrasound machine
6.2. Identify the unique characteristics for each of the types of transducer scan heads used in real-time ultrasound
6.3. Describe current ultrasound image display formats (pie-shaped, rectangular, trapezoidal, circular)
6.4. Describe the different ultrasound image recording formats (Polaroid film, single emulsion film, thermal paper, magnetic tape/discs, compact discs – DICOM {Digital Imaging and Communications in Medicine} standard, and optical disks)
6.5 Describe A-Mode
6.6 Describe B-Mode
6.7 Describe M-Mode

7.0 BUILDING WIRING

7.1 List standards used in the electrical wiring of medical buildings
7.2 Explain methods of pre-wiring and ways to wire existing buildings
7.3 Explain NEC® or other safety rules pertaining to building wiring and grounding

8.0 BASIC RADIOGRAPHIC EQUIPMENT

8.1 List the main function of an X-ray machine
8.2 State the different types of X-ray machines (Fluoroscope, cine, chest, dental)
8.3 Sketch a circuit diagram of an X-ray tube
8.4 Sketch a circuit diagram of an X-ray machine
8.5 Describe the anode "heel effect" (density issues)
8.6 Describe the focal spot
8.7 Explain the purpose of grids
8.8 Explain the purpose of the 'bucky' assembly (x-ray cassette holder)
8.9 Identify dental X-ray machine components
8.10 Identify portable X-ray machine components
8.11 Identify general 'Rad-room' ((Radiographic room) components
8.12 Identify 'Cath Lab' (catheterization laboratory) components

9.0 FILM PROCESSING

9.1 Describe Wet Processing
9.2 Identify Chemicals and Functions
9.3 Describe Dry Processing
9.4 Identify and Describe Laser Imaging Process
9.5 Describe function and makeup of X-ray Cassettes
9.6 Describe and Identify X-ray film types
9.7 State dark-room procedures
9.8 Describe film duplication process
9.9 Describe proper cassette loading technique

10.0 TEST EQUIPMENT

- 10.1 Explain the purpose of a Dosimeter
- 10.2 Demonstrate proper operation of an Oscilloscope
- 10.3 Demonstrate proper operation of a DMM (or DVM) (Digital Multimeter)
- 10.4 Demonstrate proper operation of a milliammeter (measuring in milliamperes)
- 10.5 Explain the application of an Ion chamber
- 10.6 Explain the application of the half-value layer

11.0 MAGNETIC RESONANCE IMAGING

- 11.1 Identify Magnet types
- 11.2 Describe the Fourier Process
- 11.3 Identify Cryogens
- 11.4 Describe T1 and T2 weighted spin echo
- 11.5 State purpose of Gradients
  - 11.5.1 GRASS (Gradient Recalled Acquisition in Steady State)
  - 11.5.2 SPGR (Spoiled Gradient Recalled Acquisition in the Steady State)
- 11.6 Identify Coils
- 11.7 State purpose of auxiliary coils
- 11.8 Explain RF leakage
- 11.9 Identify image produced with metal in bore

12.0 COMPUTED TOMOGRAPHY

- 12.1 Define computed tomography (CT scan)
- 12.2 Identify the components of computed tomography (gantry • tube/detectors • generator • couch - computers • applications • reconstruction • display)
- 12.3 Describe the formation of the image
- 12.4 Describe computed tomography dose index (CTDI)
- 12.5 Describe multiple scan average dose (MSDA)
- 12.6 Describe beam geometry
- 12.7 Describe measuring dose
- 12.8 Describe Protocol selection options (i.e. kvp, mAs, slice thickness, feed, matrix, algorithm)

13.0 NUCLEAR MEDICINE

- 13.1 Identify the major components of a scintillation camera and label them correctly on a diagram
- 13.2 List the function of scintillation camera collimators
- 13.3 Identify the material of which scintillation camera collimators are made.
- 13.4 Identify the chemical composition of a scintillation crystal and its physical characteristics
- 13.5 List the environmental factors that can adversely affect a scintillation crystal
- 13.6 Identify the purpose of a photo multiplier tube in a scintillation detector system
- 13.7 Describe the function of a pulse height analyzer in a scintillation detector system
- 13.8 Differentiate between planar, SPECT, and PET

14.0 CODES AND REGULATIONS

- 14.1 State pertinent NFPA 99 chapters, Section 8
- 14.2 Explain American College of Radiology (ACR) regulations
- 14.3 List the Labeling Criteria per 21CFR (Code of Federal Regulations)
- 14.4 List the safety indicators required per 21CFR
- 14.5 Enumerate fluoroscopic time limits
- 14.6 State required accuracy of mA measurements
- 14.7 State required accuracy of kVp measurements
- 14.8 State required accuracy of timer
- 14.9 State required accuracy of light field
- 14.10 State the three major organizations involved in setting the safe limits of radiation dosage

15.0 TROUBLESHOOTING

15.1 Describe proper usage of test equipment
15.2 Describe "Last good, first Bad" method of troubleshooting
15.3 Describe "divide and conquer" method of troubleshooting
15.4 Explain how to use static-arresting test procedures
15.5 Describe diagnosis and repair of defective electronic imaging equipment

16.0 RADIATION SAFETY

16.1 State the importance of exposure time in regard to safety
16.2 State the importance of shielding in regard to safety
16.3 State the importance of distance from source in regard to radiation safety
16.4 Describe the safe handling of Isotopes
16.5 Describe the safe handling of Cryogens
16.6 Describe the reasons for non-ferrous tools in the MRI suite
16.7 Describe the Thomson Effect
16.8 Describe the purpose of a film badge
16.9 State the inverse square law
16.10 State the potential lethal dose of x-radiation for humans

17.0 RADIATION PHYSICS

17.1 Define Ionizing radiation
17.2 State the diagnostic (measurement) function of an X-ray machine
17.3 Explain how X-rays are produced
17.4 Explain decay rate
17.5 Describe hard and soft radiation

18.0 LINEAR ACCELERATORS

18.1 Describe a cyclotron
18.2 Explain how a cyclotron may be utilized for treatment (particle accelerator)
18.3 Describe the betatron (cyclic particle accelerator)
18.4 Discuss the major differences between a cyclotron and betatron
18.5 Discuss how a neutron beam is generated
18.6 Name the types of isotope treatment units
18.7 State the function of a linear accelerator treatment unit
18.8 Name the types of beams produced by a linear accelerator and state their uses
18.9 List types of linear accelerator designs utilized to accelerate electrons
18.10 List the functions of the major block diagram components and auxiliary systems of a medical linear accelerator
18.11 Name the common types of external beams utilized in radiotherapy

End of Biomedical Imaging Equipment Technician Competencies
(with 18 major Categories)

Find An ETA Test Site:
http://www.eta-i.org/testing.html

Suggested Study Materials:

Introduction to Biomedical Instrumentation: The Technology of Patient Care, 2E; Christie; ISBN 978-1107185012; Cambridge University Press; 2017; ppg 244.
Biomedical Instrumentation Systems; Chatterjee and Miller; ISBN 978-1418018665; Delmar Cengage Learning; 2010; ppg 704. Available through ETA® International at 800-288-3824 or www.eta-i.org
Introduction to Biomedical Equipment Technology, 4E; Carr, Brown; ISBN 978-0130104922; Prentice Hall, 2000; ppg. 743.
http://www.mriquestions.com/index.html; www.radiopaedia.org;

ETA certification programs are accredited through the ICAC, complying with the ISO/IEC 17024 standard.

