BIOMEDICAL IMAGING EQUIPMENT TECHNICIAN
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.

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 vs. Cartilage and list differences between the two
- 1.5 Identify Ligament vs. 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 Explain the difference between single twisted pair and CAT-5
- 3.4 Define network control points
- 3.5 Define database
- 3.6 Demonstrate 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

5.1 Explain electrical surge potentials
5.2 List ways of preventing damage from electrical surges
5.3 Describe the Internet and its application to imaging modalities
5.4 Explain TCP/IP duties and protocols
5.5 Describe security problems with the Internet
5.6 Describe Tele-radiology
5.7 Describe Picture Archive Communication system
5.8 List major components of Picture Archive Communication system
5.9 Describe the intranet and its application to imaging modalities
5.10 Explain basic computer/ network maintenance procedures

6.0 DIAGNOSTIC ULTRASOUND 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, magnetic disks, 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 "heel effect"
8.6 Describe the focal spot
8.7 Explain the purpose of grids
8.8 Explain the purpose of the ‘bucky’
8.9 Identify dental X-ray machine components
8.10 Identify portable X-ray machine components
8.11 Identify general ‘rad-room’ components
8.12 Identify ‘cath lab’ 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 Demonstrate 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 DVM
10.4 Demonstrate proper operation of a milliammeter
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 Fourier Process
11.3 Identify Cryogens
11.4 Describe T1 and T2
11.5 State purpose of Gradients
11.6 Identify Coils
11.7 State purpose of auxiliary coils
11.8 Identify RF leakage
11.9 Identify image produced with metal in bore

12.0 COMPUTED TOMOGRAPHY

12.1 Define computed tomography
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
14.2 Explain ACR regulations
14.3 List the Labeling Criteria per 21CFR
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 Demonstrate 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 Demonstrate how to use static-arresting test procedures
15.5 Demonstrate 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
18.3. Discuss how a neutron beam is generated
18.4. Describe the betatron
18.5. Discuss the major differences between a cyclotron and betatron
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)

Notes:

The purpose in distributing the above Competencies list 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 Categories and Competencies listings.

Find An ETA Test Site:

http://www.eta-i.org/testing.html

Suggested Study Materials:

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 Instrumentation: The Technology of Patient Care; Christie; ISBN 978-0521515122; Cambridge University Press; 2009; ppg 248.

Introduction to Biomedical Equipment Technology, 4E; Carr, Brown; ISBN 978-0130104922; Prentice Hall, 2000; ppg. 743.

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