

# BIOMEDICAL IMAGING EQUIPMENT TECHNICIAN COMPETENCY REQUIREMENTS - 2011



*Can be used as a 'stand-alone' ETA Certification, or as the Journeyman Option specialty exam for the Certified Electronics Technician, CET.*

Biomedical Electronics Technicians must be knowledgeable and have abilities in the following technical and human relations 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 Cryogenes
- 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:

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

**Glen Wolfe, CET, Chairman**

