### Course Competency

**Competency 1:** Students will be able to demonstrate an understanding of various detectors used in the field of nuclear medicine by:

1. Describing the operation of the electrical components of various radiation detecting systems.
2. Describing the function of amplifiers and preamplifiers.
3. Describing pulse-size characteristics for an ion chamber when operated in the ion chamber region, the proportional region, and the G-M region, describing the gas-detector response as a function of voltage, and stating the basic principles of operation of gas detectors.
4. Discussing the principles of operation of the pocket dosimeter, Cutie-pie, and dose calibrator.

**Competency 2:** Students will be able to demonstrate an understanding of scintillation devices by:

1. Listing and describing the function of each component of a NaI(Tl) scintillation detector.
2. Discussing scintillation measuring techniques.
3. Describing the characteristics of the scintillation detection crystal.
4. Describing the basic physical concepts involved with scintillation spectrometry, the practical operation of the scintillation detector, and the practical operation of the pulse-height analyzer portion of the spectrometer.
5. Giving the necessary energy information and determining proper gain settings.

### Learning Outcomes

- Critical thinking

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6. Describing the basic use of scintillation spectrometers, as well as the importance of proportional linearity between gamma energy and voltage pulse output.
7. Operating a solid scintillation counter and demonstrating this ability by obtaining a gamma ray spectrum using a single channel analyzer.
8. Discussing the use of sealers, timers, and rate meters in a scintillation detector.
9. Explaining the principles of liquid scintillation counting and listing and describing the three counting methods.
10. Stating the requirements for counting vials.

**Competency 3:** Students will be able to demonstrate an understanding of counting statistics by:

1. Comparing and contrasting solid scintillation systems with liquid scintillation systems in terms of the type of radiation detected, fluor or scintillation used, energy transfer, energy resolution, and efficiency.
2. Determining a statistically accurate counting rate for a radiation detector.
3. Defining and differentiating between resolving time and dead time.
5. Calculating, comparing, and contrasting efficiency of gamma and beta emitters when using gas-filled detectors with scintillation detectors.
6. Calculating mean, standard deviation, and reliability factor, given a set of nuclear counting events.
7. Calculating what percentage of values for a Gaussian distribution fall within 1, 2, or 3 standard deviations.
8. Calculating the mean and standard deviation of a single count value as related to the Poisson distribution.
9. Calculating a Chi-square test and obtaining a P value from a given set of date points.

**Competency 4:** Students will be able to demonstrate an understanding of crystals and collimators by:
1. Discussing the development of the Anger scintillation camera, including the types and numbers of photomultiplier tubes, crystal diameter and depth, collimators, light pipes, and changes in the electronics.
2. Describing the physical parameters of collimators and crystals with particular attention to crystal diameter and thickness.
3. Explaining the advantages and disadvantages inherent in the use of thin crystal parameters.
4. Stating the characteristics of the parallel-hole, diverging, converging, and pinhole collimators as they relate to the Anger scintillation camera.
5. Stating the physical parameters and uses of low-energy, medium-energy, and high-energy collimators.

**Competency 5:** Students will be able to demonstrate an understanding of quality control as it relates to the use and care of nuclear medicine equipment by:

1. Explaining the function of the x, y, and z signals used in a gamma camera system, discussing the significance of the signals in the production of an accurate image on the display screen.
2. Describing the effects of astigmatism and focus on the final image.
3. Discussing the purpose and use of multiple lenses on a multiformat imager.
4. Discussing the dead time and framing time considerations with multiformat images.
5. Describing methods for evaluating the spatial resolution of a collimator for an Anger scintillation camera.
6. Explaining the relationship between detector size and the number of passes required in a whole body camera system.
7. Differentiating between intrinsic resolution and extrinsic resolution and extrinsic resolution as they relate to gamma camera resolution, and describing procedures that can be used to measure each.
8. Listing and discussing factors related to camera sensitivity.
9. Defining the term "field uniformity".
10. Describing in detail the various factors that cause camera nonuniformity, stating resulting potential effect on image quality.
11. Defining the term "resolving time".
12. Describing the effect on an image when the wrong energy level collimator is used.
13. Describing the effect on an image when the following situation occurs:
   a. cracked or fractured crystal
   b. improper PM tube calibration
   c. improper pulse-height analyzer calibration
   d. improperly focused CRT
   e. unclean CRT

**Competency 6:** Students will be able to demonstrate an understanding of basic medical computing by:
1. Comparing and contrasting analog and digital computer systems and signals.
2. Describing the organization and function of the central process unit of a computer.
3. Describing how information is stored in a computer memory, including various memory system in the discussion.
4. Stating factors that determine actual computer memory capacity.

**Course Competency 7:** Students will be able to demonstrate an understanding of image recording devices by:
1. Explaining what a cathode ray tube (CRT) is.
2. Discussing the difference between a persistence-scope and a CRT.
3. Naming the imaging devices available to NM.
4. Discussing how matrix size impacts image display.

**Course Competency 8:** Students will be able to demonstrate an understanding of SPECT and PET Imaging by:
1. Discussing the construction of tomographic related with the use of SPECT and/or PET imaging systems.
2. Listing and describing factors that limit statistical accuracy in SPECT imaging.
3. Listing conditions or pathologies for which SPECT imaging is advantageous over planar imaging.
4. Stating radiopharmaceutical requirements that must be satisfied in order to do PET imaging.

**Course Competency 9:** Students will be able to demonstrate an understanding of Image Processing by:

1. Comparing and contrasting the various types of display systems used on nuclear medicine computers.
2. Describing the relationship between a ROI and a histogram generated from a dynamic study.
3. Describing the acquisition and processing of nuclear medicine studies on the computer system, including but not limited to: gated, first-pass, and quantitative ventilation/perfusion lung imaging, and SPECT imaging procedures.
4. Describing the use of the computer in development and administration of quality assurance testing of imaging equipment.

**Course Competency 10:** Students will be able to demonstrate Quality Assurance (QA) by:

1. Defining and using the terminology associated with quality assurance/control in the proper text
2. Presenting a clear explanation of the sources of quality assurance/control regulations and procedures using appropriate terminology
3. Preparing a report about the effect of quality control on the quality of patient care in general and its application to nuclear medicine
4. Identifying the regulatory agencies that affect the practice of nuclear medicine, including specific regulations of the various agencies, the scope of their

- Communication
- Numbers / Data
- Critical thinking
- Information Literacy
- Ethical Issues
- Computer / Technology Usage
power, and enforcement considerations related to compliance versus noncompliance
5. Identifying methods and problems associated with standardization of quality assurance at the institutional level
6. Outlining a standardized medical informatic system and discussing the rationale for each type of record
7. Explaining which parameters of a quality control program are recorded daily, weekly, monthly and at other periodic intervals and giving a rationale for the time factors
8. Discussing the function of the various types of calibrated sealed sources