BROWARD COMMUNITY COLLEGE
COURSE OUTLINE

LAST REVIEW: **2008-2009** *(i.e. 2003-2004)* **NEXT REVIEW:** **20013-2014** *(i.e. 2008-2009)* **STATUS:** **A** *(A, I, D)*

COURSE TITLE: **Nuclear Medicine Instrumentation**

COMMON COURSE NUMBER: **NMT 2534**

CREDIT HOURS: 3

CONTACT HOUR BREAKDOWN
(per 16 week term)

CLOCK HOURS:
(Voc. Course ONLY)

Lecture: *48* Lab: *0*

Clinic: *0* Other: *0*

PREREQISITE(S):
COREQUISITE(S):
PRE/COREQUISITE(S): **NMT 2130; NMT 2485; and NMT 2705L**

COURSE DESCRIPTION
Integrates and correlates the principles of electrical and nuclear physics associated with the operation and calibration of radiation detection devices employed in nuclear medicine.

UNIT TITLES

1. Introduction to Detectors
2. Scintillation Detection Systems
3. Counting Statistics
4. Scintillation Crystals and Collimators
5. Quality Control of Nuclear Medicine Equipment
6. Basic Medical Computing
7. Image Recording Devices
8. SPECT and PET Imaging
9. Image Processing

ASSESSMENT:

Please provide a brief description (250 characters maximum) that details how students will be assessed on the course outcomes.

1. **Announced and unannounced quizzes and Unit examinations:**
2. **Mid term and/or Final Exam (cumulative/comprehensive);**
3. **Assessment of reading and online assignments via submission of homework projects.**

****** Complete the following only if course is seeking general education status ******

GENERAL EDUCATION Competencies and Skills *:

Please highlight in green font all Competencies/Skills from the list below that apply to this course. In the box to the right of the
Competency/Skill, enter all specific learning outcome numbers (i.e. 1.1, 2.7, 5.12) that apply.

1. Read with critical comprehension	
2. Speak and listen effectively	
3. Speak and listen effectively	
4. Think creatively, logically, critically, and reflectively (analyze, synthesize, apply, and evaluate)	
5. **Demonstrate and apply literacy in its various forms:**	
6. Apply problem solving techniques to real-world experiences	
7. Apply methods of scientific inquiry	
8. Demonstrate an understanding of the physical and biological environment and how it is impacted by human beings	
9. Demonstrate an understanding of and appreciation for human diversities and commonalities	
10. Collaborate with others to achieve common goals.	
11. Research, synthesize and produce original work	
12. Practice ethical behavior	
13. Demonstrate self-direction and self motivation	
14. Assume responsibility for and understand the impact of personal behaviors on self and society	
15. Contribute to the welfare of the community	

** General Education Competencies and Skills endorsed by '05-'06 General Education Task Force*

Common Course Number: NMT 2534

Unit 1 Introduction to Detectors

General Outcome:

1.0 The student shall be able to demonstrate an understanding of various detectors used in the field of nuclear medicine.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

1.1 Describe the operation of the electrical components of various radiation detecting systems.

1.2 Describe the function of amplifiers and preamplifiers.

1.3 Describe pulse-size characteristics for an ion chamber when operated in the ion chamber region, the proportional region, and the G-M region; describe the gas-detector response as a function of voltage; and state the basic principles of operation of gas detectors.

1.4 Discuss the principles of operation of the pocket dosimeter, Cutie-pie, and dose calibrator.

Common Course Number: NMT 2534

Unit 2 Scintillation Detection Systems

General Outcome:

2.0 The student shall be able to demonstrate an understanding of scintillation devices.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

2.1 List and describe the function of each component of NaI(T1) scintillation detector.

2.2 Discuss scintillation measuring techniques.

2.3 Describe the characteristics of the scintillation detection crystal.

2.4 Describe 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.

2.5 Given the necessary energy information, determine proper gain settings.

2.6 Describe the basic use of scintillation spectrometers, as well as the importance of proportional linearity between gamma energy an voltage pulse output.

2.7 Operate a solid scintillation counter and demonstrate this ability by obtaining a gamma ray spectrum using a single channel analyzer.

2.8 Discuss the use of scalers, timers, and rte meters in a scintillation detector.

2.9 Explain the principles of liquid scintillation counting, listing and describing the three counting methods.

2.10 State the requirements for counting vials.

Common Course Number: NMT 2534

Unit 3 Counting Statistics

General Outcome:

3.0 The student shall be able to demonstrate an understanding of counting statistics.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

3.1 Compare and contrast solid scintillation systems with liquid scintillation systems in terms of the type of radiation detected, flours or scintillation used, energy transfer, energy resolution, and efficiency.

3.2 Determine a statistically accurate counting rate for radiation detector.

3.3 Define and differentiate between resolving time and dead time.

3.4 Compare and contrast dead time of gas-filled detectors with scintillation detectors.

3.5 Calculate, compare, and contrast efficiency of gamma and beta emitters when using gas-filled detectors with scintillation detectors.

3.6 Calculate mean, standard deviation, and reliability factor, given a set of nuclear counting events.

3.7 Tell what percentage of values for a Gaussian distribution fall within 1, 2, or 3 standard deviations.

3.8 Calculate the mean and standard deviation of a single count value as related to the Poisson distribution.

3.9 Calculate a Chi-square test and obtain a p value from a given set of date points.

Common Course Number: NMT 2534

Unit 4 Scintillation Crystals and Collimators

General Outcome:

4.0 The student shall be able to demonstrate an understanding of crystals and collimators.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

4.1 Discuss 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.

4.2 Describe the physical parameters of collimators and crystals with particular attention to crystal diameter and thickness.

4.3 Explain the advantages and disadvantages inherent in the use of thin crystal parameters.

4.4 State the characteristics of the parallel-hole, diverging, converging, and pinhole collimators as they relate to the Anger scintillation camera.

4.5 State the physical parameters and uses of low-energy, medium-energy, and high-energy collimators.

Common Course Number: NMT 2534

Unit 5 Quality Control of Nuclear Medicine Equipment

General Outcome:

5.0 The student shall be able to demonstrate an understanding of quality control as it relates to the use and care of nuclear medicine equipment.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

5.1 Explain 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.

5.2 Describe the effects of astigmatism and focus on the final image.

5.3 Discuss the purpose and use of multiple lenses on a multiformat imager.

5.4 Discuss the dead time and framing time considerations with multiformat images.

5.5 Describe methods for evaluating the spatial resolution of a collimator for an Anger scintillation camera.

5.6 Explain the relationship between detector size and the number of passes required in a whole body camera system.

5.7 Differentiate between intrinsic resolution and extrinsic resolution and extrinsic resolution as they relate to gamma camera resolution, and describe procedures that can be used to measure each.

5.8 List and discuss factors related to camera sensitivity.

5.9 Define the term "field uniformity".

5.10 Describe in detail the various factors that cause camera nonuniformity, stating resulting potential effect on image quality.

5.11 Define the term "resolving time".

5.12 Describe the effect on an image when the wrong energy level collimator is used.

Common Course Number: NMT 2534

Unit 5 Quality Control of Nuclear Medicine Equipment continued

5.13 Describe 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

Common Course Number: NMT 2534

Unit 6 Basic Medical Computing

General Outcome:

6.0 The student shall be able to demonstrate an understanding of basic medical computing.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

6.1 Compare and contrast analog and digital computer systems and signals.

6.2 Describe the organization and function of the central process unit of a computer.

6.3 Describe how information is stored in a computer memory, including various memory system in the discussion.

6.4 State factors that determine actual computer memory capacity.

Common Course Number: NMT 2534

Unit 7 Image Recording Devices

General Outcome:

7.0 The student shall be able to demonstrate an understanding of image recording devices.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

7.1 Explain what a cathode ray tube (CRT) is.

7.2 Discuss the difference between a persistence-scope and a CRT.

7.3 Name the imaging devices available to NM
a. Formatter
b. Polaroid camera
c. Laser printer
d. Color printer
e. Computer

7.4 Discuss how matrix size impacts image display.

Common Course Number: NMT 2534

Unit 8 SPECT and PET Imaging

General Outcome:

8.0 The student shall be able to demonstrate an understanding of SPECT and PET Imaging.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

8.1 Discuss the basic design and principle enable the construction of tomographic with the use of SPECT and/or PET imaging systems.

8.2 List and describe factors that limit statistical accuracy in SPECT imaging.

8.3 List conditions or pathologies for which SPECT imaging is advantageous over planar imaging.

8.4 State radiopharmaceutical requirements that must be satisfied in order to do PET imaging.

Common Course Number: NMT 2534

Unit 9 Image Processing

General Outcome:

9.0 The student shall be able to demonstrate an understanding of Image Processing.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

9.1 Compare and contrast the various types of display systems used on nuclear medicine computers.

9.2 Describe the relationship between a ROI and a histogram generated from a dynamic study.

9.3 Describe 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.

9.4 Describe the use of the computer in development and administration of quality assurance testing of imaging equipment.