NMED-1100: COMPUTERS IN NUCLEAR MEDICINE

Cuyahoga Community College

Viewing: NMED-1100 : Computers in Nuclear Medicine

Board of Trustees:
March 2023

Academic Term:
Fall 2023

Subject Code
NMED - Nuclear Medicine Technology

Course Number:
1100

Title:
Computers in Nuclear Medicine

Catalog Description:
Study of computer systems used in the field of nuclear medicine. Topics include the gamma camera computer system interface, data acquisition, image processing software and techniques, quality control, tomography, radiopharmacy record keeping, teleradiography, and medical informatics.

Credit Hour(s):
1

Lecture Hour(s):
.5

Lab Hour(s):
1

Requisites

Prerequisite and Corequisite
Departmental approval: admission to specified program.

Outcomes

Course Outcome(s):
Discuss the components and applications of nuclear medicine computer systems.

Objective(s):
a. Describe the components of nuclear medicine computer systems.
b. Explain how nuclear medicine computer systems are used to collect, process, and store data.

Course Outcome(s):
Discuss and apply effective data processing techniques utilized in the field of nuclear medicine.

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
a. Describe the various data processing systems used in the field of nuclear medicine.
b. Apply the appropriate data processing techniques for various nuclear medicine exams.

Course Outcome(s):

Explain medical informatics applications as they apply to nuclear medicine.

Objective(s):

a. Determine how to accurately program and assess proper computer filters for high performance quality control processing images used in diagnostic imaging.
b. Understand the computer/gamma camera interfacing and what steps to take to correct poor target to background ratios.

Methods of Evaluation:

a. Quizzes
b. Exams
c. Projects
d. Worksheets

Course Content Outline:

a. Nuclear Medicine Computer Systems
    i. Gamma camera/computer interface
        1. Analog-to-digital converters
        2. Buffer
        3. Zoom
            a. Magnification versus resolution
            b. Interpolation
        4. Acquisition modes
            a. Frame
            b. List
            c. Multiple gated
            d. Tomographic
            e. Whole body
        5. Matrix types and sizes
            a. Byte versus word
            b. Number and size of pixel
            c. Voxel
        6. Memory requirements
        7. Video display systems
        8. Planar filter options
            a. Temporal
            b. Spatial/smoothing
    ii. Single-photon emission computed tomography (SPECT)
        1. Orientation
        2. Back projection
        3. Fourier reconstruction
        4. Iterative reconstruction
        5. Slice-thickness selection
        6. Reorientation
        7. SPECT filters
            a. Filter design
            b. Selection criteria
            c. Types
            d. Cutoff
            e. Frequency
            f. Nyquist frequency
            g. Multicamera head reconstruction techniques
    iii. Data processing programs
        1. Field uniformity correction
        2. Background and foreground correction
        3. Attenuation correction

4. Motion correction
5. Contrast enhancement
6. Scaling and normalization
7. Image arithmetic
8. Display manipulations
9. Dead time corrections
10. Center of rotation error corrections
11. Regions of interest
    a. Effects of poorly drawn regions of interest
12. Curve generation and image manipulation
    a. Image profiles
    b. Time-activity curves
    c. Harmonic analysis
    d. Color scales
    e. Image registration and co-registration
    f. Three-dimensional reconstruction
    g. Polar map generation
    h. Standard uptake values

b. Use of computers in quality control programs
    i. Linearity
    ii. Sensitivity
    iii. Gain
    iv. Analog versus digital conversion
    v. Resolution
    vi. Spatial distortion
    vii. Integration with imaging systems
    viii. Validation of software
    ix. Center of rotation
    x. Test patterns
    xi. Pixel sizing (x, y gain setting)
c. Radiopharmacy/hot lab computers
    i. Radiopharmacy management systems
    ii. Hot lab and patient management
    iii. Health physics
    iv. Pharmacy management
d. Processing of Nuclear Medicine Exams
    i. Skeletal Exams
    ii. Endocrine
    iii. Gastric
    iv. Respiratory
    v. Lymphatic/abscess/infection
    vi. Neurological
    vii. Cardiac
    viii. Genitourinary
    ix. Tumor
    x. SPECT
    xi. Positron Emission Tomography
    xii. Fusion imaging
e. Picture Archiving and Communication System (PACS)
    i. Acquisition device
    ii. Types of system interfaces
    iii. Digital Imaging and Communication in Medicine (DICOM)
    iv. Networking and servers
        1. Centralized servers
        2. Distribution servers
        3. Hybrids
        4. Virtual private network

v. Imaging display
vi. Printers
    1. Formatter, multi-imager
    2. Laser printer
    3. Dry film
    4. Video systems
vii. Teleradiology
viii. Archiving
ix. Internet safety within a hospital regarding PACS
x. Integration with other systems
    1. Radiology information systems (RIS)
    2. Hospital information systems

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Resources

Lee, Kai H. (2005) *Computers in Nuclear Medicine (2nd. Ed.)*, Reston, VA: Society of Nuclear Medicine.

Mettler, F., & Guiberteau, M. (2018) Essentials of Nuclear Medicine Imaging (7th. Ed.). Elsevier.

Zeissman, H., & O'Malley, J. (2013) *Nuclear Medicine: The Requisites (4th ed.). Thrall, J. (Ed.)*, Elsevier.

Bolus, N., & Glasgow, K.W., (Eds.). *Review of Nuclear Medicine Technology (5th Ed.)*, Reston, VA: Society of Nuclear Medicine and Molecular Imaging.

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Metler and Guiberteau. *Essentials of Nuclear Medicine and Molecular Imaging*. 7th ed. Elsevier, 2019.

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Bushong. *Radiologic Science for Technologists*. 11th ed. Elsevier, 2017.

Seeram and Brennan. *Radiation Protection in Diagnostic Xray Imaging*. Jones and Bartlett Learning, 2017.

Top of page
Key: 3226