

## **Course Description**

### **NMT1312C | Radiation Protection | 2.00 credits**

This course covers all local, state and federal regulations related to Nuclear Medicine. Students will learn the appropriate protection procedures to limit exposure, the performance of area surveys and wipe tests, the proper decontamination procedures, the disposal of radioactive waste procedures, and personnel monitoring of radiation exposure. Corequisites: NMT1002L, NMT2613

### **Course Competencies:**

**Competency 1:** Students will differentiate the various types of radiation and their interactions with matter by:

1. Discussing the pioneers of radiobiology and what they contributed to our knowledge of radiation today
2. Listing and explaining the different types of ionizing radiation
3. Explaining all the interactions of radiation that can occur with matter
4. Classifying the various types of radiation based on ionization characteristics
5. Defining the units of radiation exposure, absorbed dose, and dose equivalent
6. Calculating and converting between all units
7. Discussing the sources of radiation exposure to man, including natural and man-made sources
8. Explaining a cell's response to radiation and the factors that affect it
9. Comparing Direct versus Indirect Ionizing Effects on a cell
10. Identifying factors to achieve the lowest possible dose for the patient and others

**Competency 2:** Students will recognize major aspects of cell biology and radiation genetics by:

1. Listing all the structures that are found within a cell
2. Discussing the molecular components and their abundance in a cell
3. Listing all the stages of mitosis
4. Discussing significant changes that occur within each stage of mitosis
5. Listing all stages of meiosis
6. Discussing significant changes that occur within each stage of meiosis
7. Explaining what occurs in DNA synthesis
8. Discussing the causes and effects of genetic mutations that can occur
9. Discussing the effects of radiation that can occur in DNA

**Competency 3:** Students will be able to discuss cellular response to radiation by:

1. Explaining how radiation impacts cell replication and identify what stages are radiosensitive or radioresistant
2. Discussing radio sensitivity and how it relates to the cell type
3. Stating the Law of Bergonie and Tribondeau
4. Discussing the consequences of irradiation that may lead to interphase death, reproductive failure, and delay in cell division
5. Defining:
  - a. Lethal Dose
  - b. Relative Biologic Effectiveness
  - c. Linear Energy Transfer
  - d. Oxygen enhancement Ratio
6. Discussing the concept of the Target Theory
7. Explaining how physical, chemical, and biological factors can affect a cell's response to radiation

**Competency 4:** Students will be able to differentiate long and short-term effects of radiation exposure on micro and macro levels by:

1. Differentiating between acute versus late effects present in response to radiation
2. Stating the acute radiation sickness syndromes

3. Identifying the symptoms and dose range during the Hematopoietic, Gastrointestinal, and Central Nervous System syndromes
4. Defining and explaining:
  - a. Prodromal stage
  - b. Latent stage
  - c. Manifest stage
  - d. Hematologic stage
5. Discussing radiation-induced malignancies that occur with long-term effects of radiation
6. Stating the three levels of risk for a malignant disease

**Competency 5:** Students will be able to recognize personnel monitoring and dose limits by:

1. Stating factors that influence absorbed dose from internal sources
2. Listing organs and their dose limits
3. Differentiating target versus non-target organs
4. Calculating a person's absorbed dose
5. Comparing the benefits and risks of radiation hazards to a person's medical needs
6. Discussing radiation exposure, the standard doses, and the factors affecting the dose to nuclear medicine patients
7. Explaining hazards and precautions for pregnant and breastfeeding patients in nuclear medicine
8. Discussing general exposure levels in nuclear medicine
9. Stating NRC maximum permissible dose limits for the radiation worker including pregnant workers
10. Comparing occupational and public dose limits
11. Discussing the NCRP guidelines for radiation exposure to workers and the public
12. Interpreting readings on an exposure report
13. Listing various types of personnel monitors, state each one's intended use, and compare the advantages and disadvantages
14. Discussing the importance of personnel monitoring and bioassays as required by NRC regulations
15. Stating NRC rules and regulations for personnel monitoring

**Competency 6:** Students will be able to describe the rules and regulations set forth by national and state agencies that apply to a nuclear medicine facility by:

1. Discussing the ALARA radiation safety program
2. Explaining the difference between a restricted and unrestricted area, including exposure rates and required sign postage
3. Discussing in detail regulations concerning radiation detectors and monitors
4. Explaining the rules and regulations for possessing radioactive materials such as sealed sources, licensed material, activity inventory limits, and lost sources
5. Discussing NRC rules and regulations for institutional oversight including the fundamentals of a radiation safety officer and radiation safety committee
6. Discussing the rules and regulations set forth by the transportation department about the distribution of radioactive materials
7. Explaining what a written directive is and how it correlates to patient identification, dosage, medical events, and records
8. Naming and describing the various types of licenses required for the use of radioactive materials in medical practice
9. Giving appropriate data, determine the type of license that should be used, and demonstrate knowledge of the ability to complete relevant parts of the license application
10. Stating NRC regulations regarding workplace postings and instructions to workers
11. Specifying specific circumstances where improper actions or incidents require notification from the radiation officer and NRC office
12. Defining "maladministration" as applied to both diagnostic and therapeutic practice of nuclear medicine and describing the type(s) that must be filed when such an incident occurs

13. Stating the NRC regulations regarding calibration of patient doses and records that must be maintained regarding each administered dose
14. Stating NRC requirements regarding room preparation and monitoring for aerosols and or gases

**Competency 7:** Students will be able to identify radiation safety procedures by:

1. Discussing the ALARA philosophy
2. Explaining practical methods of radiation protection
3. Listing the radiation safety devices used daily by nuclear medicine technologists
4. Demonstrating the proper usage of devices used by nuclear medicine technologists
5. Discussing radiation safety procedures for workers' protection
6. Explaining regulations for safely handling and storing various forms of radioactive materials

**Competency 8:** Students will be able to describe appropriate methods of radioactive waste disposal by:

1. Discussing general requirements for waste disposal
2. Explaining the proper process of waste disposal through long- and short-term decay storage
3. Listing the allowable circumstances under which radioisotopes can be released into sanitary sewerage
4. Explaining the proper method for transferring radioactive waste to disposal
5. Discussing the correct forms of records for radioactive waste disposal

**Competency 9:** Students will be able to state the proper protocol during a minor and significant spill by:

1. Defining a significant spill
2. Defining a minor spill
3. Explaining NRC regulations for proper protocol during a significant spill
4. Explaining NRC regulations for proper protocol during a minor spill
5. Discussing the decontamination process and procedure during a significant spill
6. Discussing the decontamination process and procedure during a minor spill
7. Explaining regulations and procedures for a dose rate survey
8. Discussing regulations and procedures for a removable contamination survey
9. Defining action and trigger levels in each respective category
10. Demonstrating how to perform a room survey and wipe test properly

**Competency 10:** Students will be able to describe the fundamentals of radionuclide therapy by:

1. Stating the rules and regulations for radionuclide therapy
2. Discussing the responsibilities of the radiation safety officer and the authorized user
3. Explaining the process of dose administration
4. Discussing safety precautions that must be applied in administering radiation therapy via oral or IV radiopharmaceuticals, including for the patient, the technologist, nursing staff, and family members
5. Discussing the procedure for the administration of therapy doses to minimize radioactive contamination and exposure
6. Discussing release and isolation criteria
7. Explaining how to properly prepare a room for inpatients treated with radioactive materials and advising nursing staff about radiation safety practices
8. Discussing how to survey and monitor the room after patient discharge to determine the removal of all radioactive contamination
9. Stating restrictions in regards to radionuclide therapy
10. Stating the basic considerations of radiation disaster planning and defining the nuclear medicine technologist's role in community disaster planning

**Learning Outcomes:**

- Communicate effectively using listening, speaking, reading, and writing skills
- Solve problems using critical and creative thinking and scientific reasoning