NUCLEAR MEDICINE TECHNOLOGY — B.S.

Program director
Raynold Ho

The Program

Nuclear medicine uses radioactivity to diagnose and treat disease. This medical specialty provides information about both the structure and the function of virtually every major organ system within the body. Nuclear medicine procedures are safe, involve little or no patient discomfort, and do not require the use of anesthesia.

The nuclear medicine technologist is responsible for preparing and administering radio-pharmaceuticals; performing patient-imaging procedures; accomplishing computer processing and image enhancement; analyzing biologic specimens; and providing images, data analysis, and patient information for diagnostic interpretation by the physician health-care team member.

The Bachelor of Science degree with a major in nuclear medicine is a face-to-face program and is completed in 24 to 27 months. In addition to radiation sciences core courses, this program will include CT didactic courses. With the addition of the B.S. degree core, there are now 27 units taught online (less than 25 percent of the program). These courses are given by faculty members experienced in online teaching. Students will interact with the faculty, their classmates, and the content material.

Content for nuclear medicine courses is guided by the Society of Nuclear Medicine and Molecular Imaging (SNMMI), the Nuclear Medicine Technology Certification Board (NMTCB), and the American Registry of Radiation Technologists (ARRT) content specifications. The content for the CT courses is guided by the American Society of Radiation Technologists (ASRT), as well as the American Registry of Radiation Technologists (ARRT) specifications. Efforts are also made to assist students in experiencing the core values of Loma Linda University. The state of California requires approximately 1,000 clinical hours in nuclear medicine; this program provides more than 1,550 clinical hours in nuclear medicine and more than 250 clinical hours in CT procedures and patient care.

Objectives

During the B.S. degree in nuclear medicine technology program, students take formal coursework along with instruction in the clinical aspects of nuclear medicine. This includes participation, under close supervision, in the actual procedures within the nuclear medicine department.

Students are required to follow the guidelines given by the NMTCB and the ARRT as well as meet required competencies each quarter. Students should accomplish the required competencies in the following areas: skeletal, CNS, cardiovascular, endocrine/exocrine, gastrointestinal, genitourinary, respiratory, radiopharmacy, venipuncture, vital signs, and EKG placement and monitoring. Students will receive more than 1,550 hours of nuclear medicine and 250 hours of CT clinical experience.

Program learning outcomes

By the end of this program, the graduate should be able to:

1. Demonstrate the knowledge, skills, and responsibilities necessary for the practice of nuclear medicine;
2. Practice safe, compassionate patient care, including appreciation and respect for cultural diversity;
3. Demonstrate appropriate critical-thinking, problem-solving, and decision-making skills in nuclear medicine;
4. Maintain and apply competent skills and knowledge by interacting with fellow professionals, attending educational conferences, and staying current with changing technology;
5. Apply knowledge of departmental organization and function;
6. Apply quantitative reasoning to the practice of nuclear medicine;
7. Achieve required clinical competencies for nuclear medicine.

Professional registration and certification

Upon completion of the certificate requirements, the student is eligible to write the ARRT qualifying examination in nuclear medicine as well as the NMTCB and California (CTNM) certifying examination.

Accreditation

The Nuclear Medicine Technology Program is accredited by the Joint Review Committee on Nuclear Medicine Technology (JRCNMT), 840 West Danforth Road, B1, Edmond, OK 73003; telephone: 405/285-0546; website: <**www.jrcnmt.org**>. The program is approved by the California Department of Public Health, Radiologic Health Branch, P.O. Box 942732, Sacramento, CA 94234-7320. Loma Linda University is also accredited by the WASC Senior College and University Commission (WSCUC), 985 Atlantic Avenue, Suite 100, Alameda, CA 94501; telephone: 510/748-9001; fax: 510/748-9797; website: <https://www.wscuc.org/contact (https://www.wscuc.org/contact/)>.

Admissions

To be eligible for admission to the BSNM program, the applicant must fulfill the following requirements: Complete the prerequisite requirements, or be a graduate of an accredited radiologic technology program who has completed the prerequisite requirements in conjunction with that program.

Admission is based on a selective process. In addition to Loma Linda University (http://llucatalog.llu.edu/about-university/admission-policies-information/#admissionrequirementstext) and School of Allied Health Professions admissions requirements (http://llucatalog.llu.edu/allied-health-professions/#generalregulationstext), the applicant must also complete the following requirements:

- Minimum of 96 quarter units that are applicable to the B.S. degree program.
- G.P.A. of 3.0 or better
- A minimum of eight hours of career observation (volunteer/employee) in a nuclear medicine department is required prior to the interview. The observation form is located online <www.llu.edu (http://www.llu.edu/)> under School of Allied Health Professions, under "forms." Print it out and take it with you to the facility you will be observing.
- Interview

Certifications

Applicants must have all of the following certifications completed prior to the beginning of the school year.

- Current adult and child CPR card from the American Heart Association. Classes are available on campus at Life Support Education, University Arts building, 24887 Taylor Street, Suite 102. It

is highly suggested that the student obtain the CPR certification prior to the start of the Nuclear Medicine Program.

Prerequisite courses

Applicants must complete the following subjects at an accredited college or university prior to entering the program. Please note: C- grades are not transferable for credit.

Humanities—20 quarter (14 semester) units minimum (choose minimum of three areas from: history, literature, philosophy, foreign language, art/music appreciation or art/music history

Included in this minimum, four units of religion per year of attendance at a Seventh-day Adventist college or university

Natural sciences—Introductory or general chemistry with laboratory

Introductory or general physics with laboratory

Human anatomy and physiology with laboratory, complete sequence, two courses

College algebra (statistics does not qualify)

Social Sciences—Minimum of 12 quarter units to include:

General psychology (four quarter/three semester units) required

Choose remaining units from the following areas: sociology, anthropology, economics, and geography.

Communication—12 units English composition, complete sequence (required)

Oral communication, speech preferred, interpersonal communication is accepted

Health and Wellness—Physical education (two activities) health or nutrition

Other—Medical terminology

Electives—Meet minimum total of 96 quarter units

The diversity requirement (anthropology) is fulfilled in the portfolio core courses: AHCJ 493 Senior Portfolio I and AHCJ 494 Senior Portfolio II (approved by the University GE Committee).

For total unit requirements for graduation, see LLU General Education Requirements (http://llucatalog.llu.edu/about-university/division-general-studies/#courserequirementstext).

Program requirements

ARRT certified students

First Year

Autumn Quarter

AHCJ 493	Senior Portfolio I	3
RELE 456	Personal and Professional Ethics	3
RTCH 318	Imaging Modalities	2
RTCH 464	Moral Leadership	3
RTNM 351	Principles of Nuclear Medicine I	4
RTNM 351L	Principles of Nuclear Medicine I Laboratory	1

Winter Quarter

RTCH 387	Writing for Health-Care Professionals	3
RTNM 352	Principles of Nuclear Medicine II	4
RTNM 352L	Principles of Nuclear Medicine II Laboratory	1
RTNM 353	Nuclear Medicine Procedures I	2
RTNM 353L	Nuclear Medicine Procedures Laboratory	1
RTNM 364	Nuclear Medicine Statistics	3
RTNM 430	Clinical Affiliation Introduction	1

Spring Quarter

RTNM 354	Nuclear Medicine Procedures II	2
RTNM 354L	Nuclear Medicine Procedures II Laboratory	1
RTNM 357	Instrumentation I	4
RTNM 357L	Instrumentation I Laboratory	1
RTNM 361	Radiopharmacy I	3
RTNM 431	Clinical Affiliation I	2

Second Year

Summer Quarter

AHCJ 318	Emotional Intelligence and Leadership Skills for Health-Care Professionals	3
RTCH 305	CT Fundamentals	2
RTNM 358	Instrumentation II	4
RTNM 358L	Instrumentation II Laboratory	1
RTNM 362	Radiopharmacy II	3
RTNM 432	Clinical Affiliation II	3

Autumn Quarter

RELR 409	Christian Perspectives on Death and Dying	3
RTCH 385	Radiologic Trends in Health Care	2
RTNM 363	Nuclear Cardiology	3
RTNM 433	Clinical Affiliation III	4
RTSI 367[1]	Cross-sectional Radiographic Anatomy	2
RTSI 369[1]	CT Physics	2

Winter Quarter

RELT 436	Adventist Heritage and Health	2
RTCH 489	Effective Communication for Supervisors	3
RTNM 355	PET/CT	2
RTNM 366	Medical Informatics	1
RTNM 434	Clinical Affiliation IV	4
RTSI 364[1]	CT Patient Care and Procedures	2

Spring Quarter

RTCH 415	Radiation Emergency Procedures	3
RTCH 485	Digital Management in Radiology	3
RTNM 421	Comprehensive Review of Nuclear Medicine I	3
RTNM 435	Clinical Affiliation V	4

Third Year

Summer Quarter

AHCJ 494[2]	Senior Portfolio II	3
RTCH 467	Management of a Radiologic Service	3
RTNM 422	Comprehensive Review of Nuclear Medicine II	3
RTNM 436	Clinical Affiliation VI	4
	Total Units:	**116**

[1] The CT sequence (RTSI 364, RTSI 367, RTSI 369) may be substituted with the CT sequence (RTMR 305 Introduction to Computed Tomography I, RTMR 306 Introduction to Computed Tomography II, and RTSI 307 Introduction to Computed Tomography) completed by LLU's ASMR students.

[2] Fulfills service learning requirement

Non-ARRT certified students

First Year

Summer Quarter		**Units**
AHCJ 326	Fundamentals of Health Care	2
RTCH 283	Basic Imaging	2
RTCH 283L	Radiation Clinical Basics Laboratory	1
RTCH 285	The Principles and Physics of Radiation	4
RTMR 224	Legal Issues in Medical Radiography	1
RTMR 284	Radiation Protection and Biology	2
Autumn Quarter		
AHCJ 493	Senior Portfolio I	3
RELE 456	Personal and Professional Ethics	3
RTCH 318	Imaging Modalities	2
RTCH 464	Moral Leadership	3
RTNM 351	Principles of Nuclear Medicine I	4
RTNM 351L	Principles of Nuclear Medicine I Laboratory	1
Winter Quarter		
RTCH 387	Writing for Health-Care Professionals	3
RTNM 352	Principles of Nuclear Medicine II	4
RTNM 352L	Principles of Nuclear Medicine II Laboratory	1
RTNM 353	Nuclear Medicine Procedures I	2
RTNM 353L	Nuclear Medicine Procedures Laboratory	1
RTNM 364	Nuclear Medicine Statistics	3
RTNM 430	Clinical Affiliation Introduction	1
Spring Quarter		
RTNM 354	Nuclear Medicine Procedures II	2
RTNM 354L	Nuclear Medicine Procedures II Laboratory	1
RTNM 357	Instrumentation I	4
RTNM 357L	Instrumentation I Laboratory	1
RTNM 361	Radiopharmacy I	3
RTNM 431	Clinical Affiliation I	2
Second Year		
Summer Quarter		
AHCJ 318	Emotional Intelligence and Leadership Skills for Health-Care Professionals	3
RTCH 305	CT Fundamentals	2
RTNM 358	Instrumentation II	4
RTNM 358L	Instrumentation II Laboratory	1
RTNM 362	Radiopharmacy II	3
RTNM 432	Clinical Affiliation II	3
Autumn Quarter		
RELR 409	Christian Perspectives on Death and Dying	3
RTCH 385	Radiologic Trends in Health Care	2
RTNM 363	Nuclear Cardiology	3
RTNM 433	Clinical Affiliation III	4
RTSI 367	Cross-sectional Radiographic Anatomy	2
RTSI 369	CT Physics	2
Winter Quarter		
RELT 436	Adventist Heritage and Health	2
RTCH 489	Effective Communication for Supervisors	3
RTNM 355	PET/CT	2
RTNM 366	Medical Informatics	1
RTNM 434	Clinical Affiliation IV	4
RTSI 364	CT Patient Care and Procedures	2
Spring Quarter		
RTCH 485	Digital Management in Radiology	3
RTCH 415	Radiation Emergency Procedures	3
RTNM 421	Comprehensive Review of Nuclear Medicine I	3
RTNM 435	Clinical Affiliation V	4
Third Year		
Summer Quarter		
AHCJ 494[1]	Senior Portfolio II	3
RTNM 422	Comprehensive Review of Nuclear Medicine II	3
RTCH 467	Management of a Radiologic Service	3
RTNM 436	Clinical Affiliation VI	4
	Total Units:	**128**

[1] Fulfills service learning requirement

A minimum grade of C (2.0) is required for all courses in this program.

Normal time to complete the program

Four (4) years — Based on full-time enrollment, a student who is a radiologic technologist (ARRT) completes the LLU portion of the program in eight (8) quarters (24 months). A student who is not a radiologic technologist (Non-ARRT) starts one quarter earlier and will complete in nine (9) quarters (27 months).

Comparison

See the comparison (http://llucatalog.llu.edu/allied-health-professions/nuclear-medicine-technology-bs/comparison/) of the ARRT certified students and Non-ARRT certified students tracks of this program.

* For the CT sequence, students must take one of the two sets of CT courses : RTSI 367 Cross-sectional Radiographic Anatomy, RTSI 369 CT Physics and RTSI 364 CT Patient Care and Procedures or RTMR 305 Introduction to Computed Tomography I, RTMR 306 Introduction to Computed Tomography II and RTSI 307 Introduction to Computed Tomography (LLU ASMR Students only).

Courses

RTNM 351. Principles of Nuclear Medicine I. 4 Units.
Covers the historical developments that led to the field of nuclear medicine. Describes the structure of the atom and the factors that make an atom radioactive. Reviews the laws of physics; periodic chart of the elements; and the trilinear chart of the nuclides, radioactive decay, radionuclide production, and quality control of radiopharmaceuticals.

RTNM 351L. Principles of Nuclear Medicine I Laboratory. 1 Unit.
A laboratory course that emphasizes the material presented in RTNM 351. Structure of the atom, radioactive decay, radionuclide production.

RTNM 352. Principles of Nuclear Medicine II. 4 Units.
Includes the model of the atom, as well as electromagnetic and particle radiation. Lists the types of radioactive decay, along with the radiation interactions with matter. Defines terms that are specific to radioactive decay and performs calculations used in nuclear medicine for pre- and postcalibration of radionuclides.

RTNM 352L. Principles of Nuclear Medicine II Laboratory. 1 Unit.
A laboratory course that emphasizes the material presented in RTNM 352. Electromagnetic and particle radiations, radioactive decay interactions, and calculations.

RTNM 353. Nuclear Medicine Procedures I. 2 Units.
Addresses nuclear medicine procedures used to image, diagnose, and treat disease with radiopharmaceuticals. Identifies use of radionuclides to image the endocrine, cardiovascular, respiratory, and skeletal systems. Includes patient preparation for scans, routes of administration of radiopharmaceuticals, methods of localization for organ imaging, radiopharmacy, and quality control.

RTNM 353L. Nuclear Medicine Procedures Laboratory. 1 Unit.
A laboratory course that emphasizes the material presented in RTNM 353.

RTNM 354. Nuclear Medicine Procedures II. 2 Units.
Addresses nuclear medicine procedures used to image, diagnose, and treat disease with radiopharmaceuticals. Identifies use of radionuclides to image the endocrine, cardiovascular, respiratory, and skeletal systems. Includes patient preparation for scans, routes of administration of radiopharmaceuticals, methods of localization for organ imaging, radiopharmacy, and quality control.

RTNM 354L. Nuclear Medicine Procedures II Laboratory. 1 Unit.
A laboratory course that emphasizes the material presented in RTNM 354.

RTNM 355. PET/CT. 2 Units.
Covers the radionuclides, radiopharmaceuticals, and contrast agents used for PET/CT imaging. Topics include: localization, indications, method of administration, standard dose range, quality control, contraindications, patient history, patient preparation, equipment, technical considerations.

RTNM 356. Positron Emission Tomography. 2 Units.
Student learns the fundamental physics, instrumentation, and radionuclide requirements of positron emission tomography (PET).

RTNM 357. Instrumentation I. 4 Units.
Covers the auger/gamma scintillation camera, collimators and crystals used in nuclear medicine. Topics include: photomultiplier tubes, pulse height analyzer, resolution, count rate, field uniformity, Geiger-Mueller counter, ionization chambers, sodium iodide well counter, dose calibrator, image acquisition, matrix size, and filters.

RTNM 357L. Instrumentation I Laboratory. 1 Unit.
A laboratory course that emphasizes material presented in RTNM 357. Gamma camera components, dose calibrator, ionization chambers, and sodium iodide well counter.

RTNM 358. Instrumentation II. 4 Units.
Covers quality control of gamma cameras and dose calibrators. Topics include: data acquisition of single-photon emission computed tomography, image filtering, field uniformity assessment and correlation, X and Y gain calibration, and positron emission tomography.

RTNM 358L. Instrumentation II Laboratory. 1 Unit.
A laboratory course that emphasizes material presented in RTNM 358. Gamma camera quality control protocols, SPECT and CT images, and data acquisition.

RTNM 361. Radiopharmacy I. 3 Units.
Covers nuclear stability and decay, radionuclide production, radioactive decay, radionuclide generator systems, radionuclides, quality control, and legal requirements.

RTNM 362. Radiopharmacy II. 3 Units.
Covers the standard dose ranges, radioactive isotopes, decay tables, distribution, preparing kits, adverse reactions, and new radiopharmaceuticals.

RTNM 363. Nuclear Cardiology. 3 Units.
Covers the principles and clinical application of cardiac imaging. Topics include: patient preparation, radiopharmaceutical, localization of radiopharmaceutical, standard dose range, pharmaceutical stress protocol, exercise stress protocol, clinical applications of myocardial perfusion imaging, and image interpretation.

RTNM 364. Nuclear Medicine Statistics. 3 Units.
Covers the percent error or percent difference, counting rate determination, effects of background on counts, counting rates, standard deviation, and propagation of error.

RTNM 366. Medical Informatics. 1 Unit.
Covers information technology systems used in the health care setting. Reviews the importance of accurate documentation. Discusses the relevance of checking patient history and laboratory results using electronic medical/health record systems.

RTNM 421. Comprehensive Review of Nuclear Medicine I. 3 Units.
Reviews physics, instrumentation, procedures, imaging, and radiopharmaceutical theories in preparation for national registries.

RTNM 422. Comprehensive Review of Nuclear Medicine II. 3 Units.
Surveys selected topics in nuclear medicine. Procedure summaries, projects, literature reviews.

RTNM 430. Clinical Affiliation Introduction. 1 Unit.
First in a series of seven consecutive courses completed during the program. Provides students with clinical experience working with staff technologists and physicians, performing the functions expected of a nuclear medicine technologist and the nuclear medicine procedures involved in patient care. Clinical assignments one day per week, eight hours per day.

RTNM 431. Clinical Affiliation I. 2 Units.
Second in a series of seven consecutive courses completed during the program. Provides students with clinical experience working with staff technologists and physicians, performing the functions expected of a nuclear medicine technologist and the nuclear medicine procedures involved in patient care. Clinical assignments two days per week, eight hours per day. Prerequisite: RTNM 430.

RTNM 432. Clinical Affiliation II. 3 Units.
Third in a series of seven consecutive courses completed during the program. Provides students with clinical experience working with staff technologists and physicians, performing the functions expected of a nuclear medicine technologist and the nuclear medicine procedures involved in patient care. Clinical assignments three days per week, eight hours per day. Prerequisite: RTNM 430, RTNM 431.

RTNM 433. Clinical Affiliation III. 4 Units.
Fourth in a series of seven consecutive courses completed during the program. Provides students with clinical experience working with staff technologists and physicians, performing the functions expected of a nuclear medicine technologist, as well as the nuclear medicine procedures involved in patient care. Clinical assignments four days per week, eight hours per day. Prerequisite: RTNM 430, RTNM 431, RTNM 432.

RTNM 434. Clinical Affiliation IV. 4 Units.
Fifth in a series of seven consecutive courses completed during the program. Provides students with clinical experience working with staff technologists and physicians, performing the functions expected of a nuclear medicine technologist, as well as the nuclear medicine procedures involved in patient care. Clinical assignments four days per week, eight hours per day. Prerequisite: RTNM 430, RTNM 431, RTNM 432, RTNM 433.

RTNM 435. Clinical Affiliation V. 4 Units.
Sixth of seven courses providing clinical experience working with staff technologists and physicians, performing the functions expected of a nuclear medicine technologist and nuclear medicine procedures involved in patient care. Clinical assignments four days per week, eight hours per day. Prerequisite: RTNM 430, RTNM 431, RTNM 432, RTNM 433, RTNM 434.

RTNM 436. Clinical Affiliation VI. 4 Units.
Seventh of seven courses providing clinical experience working with staff technologists and physicians, performing the functions expected of a nuclear medicine technologist, and nuclear medicine procedures involved in patient care. Clinical assignments four days per week, eight hours per day. Prerequisite: RTNM 430, RTNM 431, RTNM 432, RTNM 433, RTNM 434, RTNM 435.