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 radiopharmaceuticals; 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 24-27 months long. In addition to adding the B.S. degree in radiation sciences core courses, this program will now have the CT didactic courses included in the curriculum. With the addition of the B.S. degree core, there will now be 27 units taught online (less than 25 percent of the program). These courses are taught by faculty experienced in online teaching. Students will interact with the faculty, their classmates, and the content material.

The content for the 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). 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). 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; and 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 Bachelor of Science degree in nuclear medicine technology program, students take formal course work 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 and 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 outcomes
Upon completion of the program, the graduate should be qualified to:

1. Skill: Demonstrate the knowledge, skills, and responsibilities necessary for the practice of nuclear medicine.
2. Compassion and Diversity: Practice safe, compassionate patient care, including appreciation and respect for cultural diversity.
3. Critical Thinking: Demonstrate critical thinking, problem solving, and decision making skills in nuclear medicine.
4. Knowledge: Maintain skills and knowledge by interacting with fellow professionals, attending educational conferences, and staying current with changing technology. Demonstrates knowledge of departmental organization and function.
5. Quantitative Reasoning: Apply quantitative reasoning to the practice of nuclear medicine.
6. Clinical: Obtain required clinical competencies including: patient care, procedures, showing how to competently utilize a variety of NM and CT equipment.

Professional registration and certification
Upon completion of the certificate requirements, the student is eligible to write the qualifying examination in nuclear medicine of the American Registry of Radiologic Technologists (ARRT); and the certifying examination of the Nuclear Medicine Technology Certification Board (NMTCB) and of the state of California (CTNM).

Accreditation
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 regionally 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; Web site: <http://www.wascsenior.org> or <http://www.wascsenior.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:

- An Associate in Science degree or equivalent (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 24 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> 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.

- Certification in Radiologic Technology (ARRT)
- Certification in Nuclear Medicine Technology (NMTCB)
- Certification in Computed Tomography (CTNM)
• Current CPR card from the American Heart Association (adult and child). 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, 4 units of religion per year of attendance at a Seventh-day Adventist college or university

Natural sciences—Chemistry (Introductory or general) with laboratory, one year (12 units)

Introductory or general physics with laboratory (4 units)

Human anatomy and physiology with laboratory, complete sequence (4 units)

College algebra (4 units)

Social Sciences—General psychology (4 units)

Cultural anthropology or an approved course dealing with cultural diversity

Introduction to Sociology (4 units)

Lifespan development (4 units)

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

Oral communication (4 units)

Health and Wellness—Physical education (two activities) (2 units)

Health or nutrition (3-4 units)

Other—Medical terminology (2 units)

Electives—Meet minimum total of 96 quarter units

The diversity requirement 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

Winter Quarter
RTCH 318 Imaging Modalities 2
RTCH 464 Moral Leadership 4
RTNM 352 Principles of Nuclear Medicine I 4
RTNM 351L Principles of Nuclear Medicine I Laboratory 1

Spring 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 I 1
RTNM 364 Nuclear Medicine Statistics 3
RTNM 430 Clinical Affiliation Introduction 1

Second Year

Summer Quarter
REL 4 Upper-division religion 2
RTCH 305 CT Fundamentals 2
RTNM 358 Instrumentation I 4
RTNM 358L Instrumentation I Laboratory 1
RTNM 362 Radiopharmacy I 3
RTNM 432 Clinical Affiliation II 3

Autumn 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

Third Year

Summer Quarter
REL 4 Upper-division religion 2
RTCH 385 Radiologic Trends in Health Care 2
RTNM 433 Clinical Affiliation III 3
RTSI 367 Cross-sectional Radiographic Anatomy 2
RTSI 369 CT Physics 2

Winter Quarter
REL 4 Upper-division religion 2
RTCH 467 Management of a Radiologic Service 3
RTNM 355 PET/CT 2
RTNM 366 Medical Informatics 1
RTNM 434 Clinical Affiliation IV 3
RTSI 364 CT Patient Care and Procedures 2

Spring Quarter
REL 4 Upper-division religion 2
RTCH 325 Applications for Managers 2
RTCH 415 Radiation Emergency Procedures 3
RTNM 421 Comprehensive Review of Nuclear Medicine I 3
RTNM 435 Clinical Affiliation V 4
Non-ARRT certified students

First Year

Summer Quarter
AHJC 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  1
RTMR 224  Legal Issues in Medical Radiography  1
RTMR 284  Radiation Protection and Biology  1

Autumn Quarter
AHJC 493  Senior Portfolio I  1
RELE 457  Christian Ethics and Health Care  2
RTCH 318  Imaging Modalities  2
RTCH 464  Moral Leadership  4
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  4

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 431  Clinical Affiliation I  2
RTNM 361  Radiopharmacy I  3

Second Year

Summer Quarter
AHJC 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
REL_ 4__ Upper-division Religion  2
RTCH 385  Radiologic Trends in Health Care  2
RTNM 363  Nuclear Cardiology  3
RTNM 433  Clinical Affiliation III  3
RTSI 367  Cross-sectional Radiographic Anatomy  2
RTSI 369  CT Physics  2

Third Year

Winter Quarter
REL_ 4__ Upper-division Religion  2
RTCH 467  Management of a Radiologic Service  3
RTNM 355  PET/CT  2
RTNM 366  Medical Informatics  1
RTNM 434  Clinical Affiliation IV  3
RTSI 364  CT Patient Care and Procedures  2

Spring Quarter
REL_ 4__ Upper-division Religion  2
RTCH 325  Applications for Managers  2
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
AHJC 494  Senior Portfolio II  3
HCAD 414  Sustainability for Health-Care Management  3
RTNM 422  Comprehensive Review of Nuclear Medicine II  3
RTNM 436  Clinical Affiliation VI  4

Total Units: 114

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

Normal time to complete the program

A student who is a radiologic technologist (ARRT) should complete the program in 8 quarters (24 months). A student who is not a radiologic technologist (Non-ARRT) starts one quarter earlier and will complete in 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.

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.
Covers the nuclear medicine procedures used to image, diagnose, and treat disease with radiopharmaceuticals. Teaches students which radionuclides are used to image the various organs in the body—such as the endocrine system, cardiovascular system, respiratory system, and skeletal system. As part of utilizing radiation in patient care, teaches the technologist how to prepare the patient for the scan, the route of administration of the radiopharmaceutical, and the method of localization for organ imaging. Provides a basic understanding of radiopharmacy and quality control of radiopharmaceuticals.

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.
Covers the nuclear medicine procedures used to image, diagnose, and treat disease with radiopharmaceuticals. Teaches students which radionuclides are used to image the various organs in the body—such as the endocrine system, cardiovascular system, respiratory system, and skeletal system. As part of utilizing radiation in patient care, teaches the technologist how to prepare the patient for the scan, the route of administration of the radiopharmaceutical, and the method of localization for organ imaging. Provides a basic understanding of radiopharmacy and quality control of radiopharmaceuticals.

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, radiopharmacological 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 382. Topics in Nuclear Medicine II. 1-3 Units.
Surveys selected topics in nuclear medicine. Procedure summaries, projects, literature reviews. May be taken concurrently with RTNM 971-974 for credit toward the baccalaureate degree.

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.
Introduces a series of six consecutive courses—RTNM 431-436—completed during the program. Provides student with clinical experience one day a week during Winter Quarter working with staff technologists and physicians performing the functions expected of a nuclear medicine technologist and the nuclear medicine procedures involved in patient care.

RTNM 431. Clinical Affiliation I. 2 Units.
Second in a series of seven consecutive courses (RTNM 430-436) 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. Specific days vary each quarter.

RTNM 432. Clinical Affiliation II. 3 Units.
Student works eight hours per day, four days per week—specific days vary with the quarter.

RTNM 433. Clinical Affiliation III. 3 Units.
Student works eight hours per day, four days per week—specific days varying with the quarter.

RTNM 434. Clinical Affiliation IV. 3 Units.
Student works eight hours per day, four days per week—specific days varying with the quarter.

RTNM 435. Clinical Affiliation V. 4 Units.
Student works eight hours per day, four days per week—specific days varying with the quarter.

RTNM 436. 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 436. Clinical Affiliation VI. 4 Units.
Student works eight hours per day, four days per week--specific days varying with the quarter.