Nuclear medicine curriculum (2026)

1. History of radiology and nuclear medicine – first important discoveries and milestones in the field of radiology and nuclear medicine. Radiation and radioactivity – atom, α, β, γ radiation, units of radioactivity and radiation exposure, and basics of radiation biology.
2. Radiation Protection – main principles. Methods for protecting patients and medical staff in nuclear medicine.
3. Radiopharmaceuticals (RPh) – definition, principles of production, nuclear reactor, cyclotron, generators. Application and radioprotection in nuclear medicine. Principles of molecular imaging. Differences between contrast media and RF.
4. Nuclear medicine technology – gamma camera, PET scanner, planar imaging, dynamic study, whole-body imaging, computers in nuclear medicine, quantitative ROI analysis, curves of function, parametric pictures.
5. Tomographic methods in nuclear medicine: SPECT, PET, and hybrid methods (SPECT/CT, PET/CT, PET/MRI) – principles, differences, advantages, and disadvantages.
6. Computers in nuclear medicine – use in image storage and processing, digitalization of imaging in NM, quantitative image analysis, Information systems, PACS, telemedicine, and AI in imaging.
7. Imaging of the musculoskeletal system – indications of 3-phase bone scan – radiopharmaceuticals, whole-body and dynamic scintigraphy, SPECT/CT.
8. Radionuclide therapy of bone metastatic disease, alpha and beta radionuclides.
9. Intra-articular therapy with 90Y-colloids and radioimmunotherapy and other therapy of tumors.
10. Imaging of inflammation and infection with nuclear medicine methods. NM methods in hematology.
11. Nuclear cardiology – methods and indications, quantitative analysis, ventriculography, perfusion scintigraphy, wall motion analysis, MIBG scintigraphy, PET, and viability of myocardium.
12. Nuclear medicine methods in pulmonary diagnostics, pulmonary embolism – diagnostic modalities CT PA and V/Q scan.

CHECK-POINT 1

13. Diagnostic process in nuclear medicine and interpretation of results; imaging methods and quality control in all steps of the diagnostic process. Principles of data interpretation and validity of results.
14. Evidence-based medicine in imaging, reproducibility, sensitivity, specificity, predictive values, ROC curves, validity, and comparison of imaging methods in diagnostics.
15. Nuclear medicine imaging in endocrinology – thyroid and parathyroid scintigraphy

16. Radionuclide therapy of thyroid hyperfunction and thyroid carcinoma. Principles and how to do it. Inpatient and outpatient care.
17. Adrenal gland pathology and imaging of neuroendocrine tumors – nuclear medicine, ^{121}I-MIBG and ^{111}In-Octreoscan, PET/CT: when to use which of them.
18. Radionuclide therapy of neuroendocrine tumors with ^{131}I-MIBG and receptor-binding RPh.
19. NM imaging methods of the digestive tract – salivary glands, esophagus, and stomach; NM Imaging of gastrointestinal bleeding and GIT motility.
20. Diagnostic imaging of liver pathology by nuclear medicine methods. Therapy of liver malignancy by radionuclide methods and necessary diagnostics for it.
21. NM imaging and measurement of the urinary tract – radiopharmaceuticals for different functions and methods: blood flow, glomerular and tubular functions, collecting system drainage – hydronephrosis, vesicoureteral reflux. Testes diagnostics.
22. Nuclear medicine methods in neuroimaging and psychiatry – receptor diagnostics, DaT scan, PET – distinguishing Parkinson's disease from other tremor syndromes and Alzheimer from other dementias.
    Nuclear medicine imaging of cerebrospinal leakage – indications and procedure.
23. Lymphoscintigraphy, sentinel lymph node scintigraphy and per-operation detection of malignant melanoma and other malignancies. NM Diagnostics in breast cancer.
24. PET/CT in oncology – principle and main indications: diagnosis of diseases, staging, and monitoring of disease. Which type of tumors? ^{18}F-FDG and new generator radiopharmaceuticals for PET.

Attendance requirements

Students must attend at least **50% of the lectures**.

Full attendance (100%) at seminars is required, with the exception of one excused absence with the obligation to make up for the class after prior arrangement with the tutor. Seminars are held once every two weeks.

Examination

The curriculum on the previous page is not a list of examination questions. It outlines the topics students are expected to study. Examples of short questions for the checkpoint assessments and other parts of the examination can be found in the headings of selected slides in the presentations.

1. **Attendance verification:** Checkpoint assessments during practical sessions will be held in person. Therefore, each assessment session will be limited to max.15 students.

2. **Continuous assessment: One checkpoint test:** One seminar will include checkpoint assessments. The format of these assessments will depend on the circumstances. The questions will cover topics taught in the preceding seminars and lectures. A student must pass the checkpoint assessment to be eligible to take the final examination. These assessments serve the same purpose as a course credit test.
3. **Final examination:** The final examination will be based on a clinical problem. A student will be asked to select an appropriate nuclear medicine procedure to investigate the problem, write a referral to the Department of Nuclear Medicine, and justify their choice. A student must be familiar with all diagnostic examinations and therapeutic methods in nuclear medicine covered in the course, including their names, indications, patient preparation requirements, and underlying principles. A student will also answer short supplementary questions on other topics covered in the lectures, including general nuclear medicine, radiation protection, and radionuclide therapy.

Knowledge requirements and grading

To pass the examination, a student must demonstrate more than 50% of the required knowledge and understand the essential concepts outlined below.

Grade FX — Fail

Students will not pass the examination if they lack essential knowledge of:

- The indications for nuclear medicine examinations and the principles of the most important methods, including SPECT and PET.
- The biological effects of ionising radiation, the principles of radiation protection, and the units of radioactivity.
- The differences between radiopharmaceuticals and contrast media.
- The differences between radiation therapy in radiation oncology and nuclear medicine.
- The difference between radiology and nuclear medicine.

Grade C

In addition to the essential knowledge required to pass, a student has to know which radiopharmaceuticals are used for the selected procedures and how patients should be prepared for these examinations. A student also has to be able to calculate sensitivity and specificity and understand the basic principles of evidence-based medicine (EBM).

Grade A

A student must demonstrate more than 90% of the required knowledge. In addition to the requirements above, a student has to be able to explain the differences between the mechanisms underlying radionuclide imaging methods and justify when and why these methods are used in comparison with other imaging modalities.

A student must also know the radiopharmaceuticals used for each procedure and the approximate radiation doses associated with radionuclide and X-ray examinations.

Repeating the course

Students who do not pass the final examination or who do not attend any of the available examination sessions must **repeat the entire course in the following academic year, including lectures and classes**. The attendance requirements outlined above will apply again.

An exception might be granted to students who have attended 100% of both lectures and classes and achieved a grade of B or higher in the checkpoint assessment. These students will not be required to repeat the lectures or practical sessions but must still pass the final examination.

Recommended literature:

1. Elgazzar AH, Alenezi SA, Taalab KM. A Concise Guide to Nuclear Medicine. 3rd Ed. Springer, 2026
2. Lectures and seminar presentations (also available at the INMM website) – ask the teacher for the password to access the website
3. European Nuclear Medicine Guide (https://doi.org/10.52717/TDVK9247)
4. EANM NucMed Clinical Decision Support (https://nucmed-cds.app/)
5. IAEA Human Health Campus (https://www.iaea.org/resources/hhc/nuclear-medicine/e-learning-courses) – especially A Guide to FDG PET-CT in Clinical Oncology, Nuclear Cardiology: Clinical Cases
6. Fred A. Mettler, Jr. and Milton J. Guiberteau. Essentials of Nuclear Medicine and Molecular Imaging 7th edition, 2019
7. AMBOSS – chapters on Ionizing radiation, Hyperthyroidism and thyrotoxicosis, Thyroid cancer, Thyroid nodules, Cardiac imaging, and Cardiac stress testing.

Internet sources: be careful; don't rely only on patient information from the internet or literature older than 10 years!!!