

1.	School	Medicine
2.	Department	Radiology
3.	Program title (Arabic)	الطب النووي
4.	Program title (English)	Nuclear Medicine
5.	Track	Higher specialization degree

	Specialization #	Degree	Dep #	Faculty #	Year	Track
Plan Number		Higher specialization				

First: General Rules & Conditions:

1- This plan conforms to the regulations of granting Jordanian Board of nuclear Medicine from the Jordanian Medical Council.

2- Only holders of Bachelor Degree in Medicine and Surgery or equivalent can be admitted to this program.

Second: Special Conditions: None.

Third: Duration of Study and training: four years.

Fourth: Study Plan:

Year	Teaching & Training	Duration
First	First year: Introduction to nuclear physics Radiation protection and radiobiology Radiation detection systems Radiopharmaceuticals Nuclear thyroidology: thyrotoxicosis and thyroid cancer Physiology and pathophysiology in nuclear medicine Radiological anatomy Principles of computer systems DEXA scan in osteoporosis	12 months
Second	Basic training in clinical U/S with emphasis on thyroid imaging (1 month). Basics of X-ray imaging: X-ray imaging with emphasis on chest	12 months

	<p>X-ray and musculoskeletal imaging (1 month)</p> <p>Training in radionuclide imaging of the genitourinary and respiratory systems (3 months)</p> <p>Introduction to Nuclear Cardiology: 2 months</p> <p>Nuclear musculoskeletal system imaging: 5 months</p>	
Third	<p>Hepatobiliary and gastrointestinal imaging: 1 month</p> <p>Introduction to Nuclear oncology: 3 months</p> <p>Lymphoscintigraphy and sentinel lymph node scintigraphy: 1 month</p> <p>Nuclear cardiology: 2 months</p> <p>Nuclear imaging of central nervous system: 1 month</p> <p>Non-thyroidal nuclear endocrine imaging: adrenals and parathyroid: 1 month</p> <p>Basic training in clinical CT: 3 months</p>	12 months
Fourth	<p>Advanced nuclear oncology with emphasis on PET/CT: 4 months</p> <p>Therapeutic applications of nuclear medicine: 4 months</p> <p>Advanced applications of nuclear cardiology: 4 months</p>	12 months

Detailed program Description & learning objectives

1. Radiological anatomy

-Describe anatomy and cross sectional anatomy of brain, head and neck, chest, abdomen and pelvis.

2. Medical Physics

- Principles of radiation detection.
- Principles of biological effects of radiation.
- Principles of interaction of radiation with matter.
- Principles of radiation protection.

3. Physiology and Pathophysiology in nuclear medicine

-Principles of major physiological and pathophysiological concepts regarding central nervous system, cardiovascular system, endocrine system, genitourinary tract, hepatobiliary and gastrointestinal tracts..

4. Information technology

- Principles of digital imaging
- Principles of computer systems

5. Principles of Diagnostic and Nuclear Medicine imaging

- Basic physics principles of conventional gamma camera, SPECT, PET, CT, MRI and ultrasound
- Describe the quality requirements for a safe and effective nuclear medicine practice

6. Radiopharmacy and radiochemistry

- Quality control of $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ generator and other radionuclide generators
Cyclotron principles
- Describe pharmacokinetics of various radiopharmaceuticals
- Quality control in Radiopharmacy

7. Cardiovascular system

- Supervise and interpret resting and exercise ECGs either alone or in collaboration with cardiologists.
- Supervise pharmacological stress studies and interpret post pharmacologic stress ECG either alone or in collaboration with cardiologists.
- Interpret rest and stress myocardial perfusion studies using SPECT radiopharmaceuticals.
- Describe the role of complementary imaging techniques for cardiac disease the role of CTCA in the management of coronary artery disease.
- Assessment of coronary artery disease using PET tracers.

8. Endocrinology

- Assessment and management of clinical and subclinical hyperthyroidism .
- Assessment and management of nodular thyroid disease.
- Assessment and nuclear imaging of hyperparathyroidism.

- Assessment and nuclear imaging of adrenal hypersecretory syndromes.
- Describe the role of complementary imaging techniques for endocrine diseases.

9. Gastroenterology:

- Assessment and nuclear imaging of gastrointestinal motility disorders.
- Assessment and nuclear imaging of hepatic lesions.
- Assessment and nuclear imaging of gallbladder and biliary function using hepatobiliary scans
- Assessment and nuclear imaging of GI hemorrhage
- Assessment and nuclear imaging of inflammatory bowel disease (IBD) and intra-abdominal sepsis
- Assessment and nuclear imaging of abnormal splenic function using Tc-99m labeled tracers
- Assessment and nuclear imaging of hepatic artery catheters and peritoneal-venous shunts using Tc-99m labeled tracers
- Assessment and nuclear imaging of salivary and lacrimal glands
- Describe the role of complementary GI imaging techniques in the assessment of GI diseases
- Assessment of patients using C-14 urea breath tests to evaluate Helicobacter pylori infection
- Assessment of patients using C-13/14 breath tests to evaluate intestinal absorption
- T Genitourinary

10. Genitourinary system:

In vitro and In vivo assessment of renal function

- Assessment and nuclear imaging of urinary tract obstruction
- Assessment and nuclear imaging of renal infection
- Assessment and nuclear imaging of renovascular hypertension
- Assessment and nuclear imaging of renal transplant
- Assessment and imaging of vesicoureteral reflux
- Assessment of renal failure
- Assessment and nuclear imaging of renal cortical abnormalities via Tc-99m DMSA scan
- Use of testicular nuclear scan for assessment of testicular torsion

-Describe the role of complementary imaging techniques in the assessment of genitourinary diseases

11. Musculoskeletal system

- Describe techniques of conventional bone scintigraphy and PET imaging for assessment of musculoskeletal disease
- Nuclear imaging of primary benign and malignant bone tumors
- Nuclear imaging of metastatic bone disease
- Nuclear imaging of musculoskeletal trauma
- Nuclear imaging of metabolic bone disease
- Nuclear imaging of skeletal infection
- Nuclear imaging of prosthetic joint replacements
- Nuclear imaging of patients following spinal surgery
- Nuclear imaging of arthritis and related conditions
- Describe the role of complementary musculoskeletal imaging modalities
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12. Neurological Nuclear Medicine

- Assessment and nuclear imaging of brain perfusion and function using SPECT and PET with emphasis on dementia and epilepsy
- Assessment and nuclear imaging of disorders of CSF flow and suspected CSF leaks
- Assessment and nuclear imaging of brain death
- Identify emerging brain SPECT and PET techniques

13. Infection and inflammation:

- Assessment of infection and inflammation using nuclear medicine techniques
- Describe the emerging role of PET in the assessment and imaging of inflammation or infection

14. Osteoporosis

- Describe techniques used to evaluate osteoporosis
- Identify quality assurance procedures in bone mineral density (BMD) estimation
- Interpret and report lumbar spine BMD scans
- Interpret and report proximal femur BMD scans
- Assessment of BMD in appendicular skeleton

- Outline absolute fracture risk?

15. Pulmonary Nuclear Medicine

- Describe the assessment of, management, and outcomes of pulmonary embolism (PE) and deepvenous thrombosis (DVT)
- Assessment of PE using ventilation and perfusion imaging by planar and SPECT techniques.
- Describe the role of ancillary tests and complementary imaging techniques for PE
- Assessment of patients by quantification of lung ventilation and perfusion
- Assessment of inflammatory lung disease

16. Oncological Nuclear Medicine

- Assessment of oncological disorders with F-18 FDG PET:
- Assessment and nuclear imaging of patients with lung cancer
- Assessment and nuclear imaging of patients with GI malignancies, including esophageal and pancreatic cancers
- Assessment and nuclear imaging of patients with breast cancer
- Assessment and nuclear imaging of patients with head and neck malignancies
- Assessment and nuclear imaging of patients with melanoma
- Assessment and nuclear imaging of patients with neuroendocrine tumors
- Assessment and nuclear imaging of patients with lymphoma and other hematological malignancies
- Assessment and nuclear imaging of patients with gynecological malignancies
- Assessment and nuclear imaging of patients with sarcoma
- Assessment and nuclear imaging of primary bone tumors
- Assessment and nuclear imaging of skeletal metastatic disease
- Assessment and nuclear imaging of patients with brain malignancy
- Assessment and nuclear imaging of renal cell and bladder cancers
- Use SPECT and PET tracers (other than F-18 FDG) to characterize tumors, especially prostate cancer
- Describe the use of radiological imaging to assist in the interpretation of oncological nuclear medicine studies

Identify the indications for and interpretation of other oncological radiopharmaceuticals, in particular ^{68}Ga DOTATOC and ^{68}Ga PSMA and other emerging nuclear medicine techniques

17. Therapeutic Nuclear Medicine

- Treatment of hyperthyroidism and other benign thyroid diseases with I-131
- Ablation of residual thyroid tissue following thyroidectomy for differentiated thyroid cancer and Treatment of persistent and metastatic differentiated thyroid cancer
- Palliative treatment of bone pain due to metastatic disease using therapeutic bone-seeking radiopharmaceuticals
- Treatment of arthritis with radiation synovectomy
- Treatment of polycythemia vera and essential thrombocytosis
- Peptide receptors radionuclide treatment of neuroendocrine tumors
- Treatment of liver malignancy/metastatic disease with intra-arterial therapy
- Radiolabeled antibody treatment of lymphomas and other hematologic malignancies

18. Lymphatic system

- Assessment and nuclear imaging of lymphedema
- Describe the concept of sentinel lymph node, techniques of sentinel lymph node scintigraphy and principles of intraoperative radioguided procedures
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Expected Outcomes at the Completion Of Training

Graduates from this training program will be equipped to function effectively within the current and emerging professional, medical and societal contexts. At the completion of the Joint Program in Nuclear Medicine and Molecular Imaging, as defined by this curriculum, it is expected that graduates of the program will have developed the clinical skills and have acquired the theoretical knowledge for competent nuclear medicine practice. It is expected that graduates of this nuclear medicine program will have:

1. High-level skills in the technical processes and routine procedures undertaken in the specialty
2. An approach to clinical judgment and to the practice of nuclear medicine that focuses on the clinical setting and on the pathophysiological processes involved in each case
3. The ability to apply a well-developed and appropriately structured knowledge base in internal and nuclear medicine and correlative imaging to the primary areas of professional practice of the specialty
4. Research skills to support ongoing evidence-based practice in the specialty
5. High-level communication skills, especially in the explanation and reporting of procedures and studies employed in the specialty. Graduates of the program will be able to employ these skills with referring doctors, other health professionals, and with patients and members of their families
6. Well-developed educational skills to support a teaching role in areas related to the specialty, especially with medical students, junior staff, allied health professionals, and members of the public
7. Quality assurance skills to enable the implementation and ongoing evaluation of nuclear medicine practice to a high technical and professional standard
8. Organizational skills to support independent practice in nuclear medicine, as well as contributions to and leadership of hospital teams
9. High standard of ethical and professional behaviour.

Evaluation

- Evaluation is carried out on a unified basis and takes into account the following skills and points:

Communication skills

Attendance,

Theoretical knowledge

Procedural skills

Documenting medical information,

Feedback from colleagues, supervisors and patients.