האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

introduction to nuclear medicine - 64890

Last update 29-12-2014

HU Credits: *4*

Degree/Cycle: *2nd degree (Master)*

Responsible Department:

Academic year: *3*

Semester: *1st Semester*

Teaching Languages: *Hebrew*

Campus: *Ein Karem*

Course/Module Coordinator: *PROF. EYAL MISHANI*

Coordinator Email: *eyalmi@ekmd.huji.ac.il*

Coordinator Office Hours:

Teaching Staff:

Prof Eyal Mishani
Prof Michael Paul

Galith Abourbeh

Course/Module description:

The course presents the various aspects of biomedical nuclear molecular imaging, and is divided into five chapters. The first chapter introduces in detail the fundamentals of nuclear physics (nuclear structure, the essence of radioactivity, interactions of radiation/particles with matter, radiological effects and safety, nuclear reactors, accelerators, generators and detectors). The second chapter presents the production methods of common radioisotopes in nuclear medicine (NM) (carbon-11, nitrogen-13, fluorine-18, iodine-124, technetium-99m) and their characteristics. In the third chapter, the prevailing scanners in NM (gamma cameras and PET scanners) are presented, and their characteristics (detectors and functional principles) are discussed. The fourth chapter introduces the general requirements of radiopharmaceuticals in NM, chemical (radiosynthetic) routes of preparation and quality control processes. In the fifth part, clinical and research applications of molecular nuclear imaging in cardiology, oncology and neurology are discussed.

Course/Module aims:

To provide basic knowledge of the various physical, chemical and biological aspects involved in the discipline of nuclear molecular imaging, with particular emphasis on radiopharmacy, radiopharmaceuticals and apparatus. Students taking the course should become familiar with the potential of biomedical NM imaging as a research and diagnostic tool.

Learning outcomes - On successful completion of this module, students should be able to:

The course confers fundamental knowledge in the discipline of research, development and use of radiopharmaceuticals in NM. Students participating in the course should become familiar with the NM-related terminology, the advantages and disadvantages of NM imaging compared to alternative (non-NM) imaging techniques, the prevailing imaging modalities in NM, common radiopharmaceuticals used in the clinical setting and the potential research applications.

Attendance requirements(%):

Teaching arrangement and method of instruction: Lectures

Course/Module Content:

Physics – Introduction

Structure and composition of the nucleus (nuclear mass and radius, nuclear-bond energy), radioactivity, interaction of radiation and matter, radiological effects and safety, apparatus: nuclear reactors, accelerators, generators and detectors. Stable vs. unstable nuclei, decay constant, half life, radioactivity, specific activity and their corresponding units of measure. Natural and artificial radioactivity: types and characteristics of various forms of decay (alpha, beta+, beta- and gamma), interaction of radiation/particles with matter: photoelectric absorption, Compton scatter, pair production, electron-capture and positron-electron annihilation. Radiation safety: exposure, dose, dose-rate and physical principles of radiation dosimeters.

Production, Characteristics and Evaluation of Isotopes for Biomedical Use

Production routes, nuclear reactions, isotopes' characteristics, specific radioactivity, common radioisotopes in NM imaging and therapy.

Requirements and characteristics of radioisotopes for imaging and therapy in NM: carbon-11, fluorine-18, mitrogen-13, iodine-124, gallium-68, bromine-76, copper-64, yttrium, luthetium, technetium, indium and rhenium. Purification and purity assessment, nuclear reactions: accelerators, reactors and production of radioactive isotopes in generators. Specific activity (theoretical and practical) and common decay pathways of radioactive isotopes used in NM.

Apparatus in NM

Operation principles of common NM imaging apparatus (clinical and preclinical scanners). Old vs. new (solid-state) detectors, their associated electronics, principles of imaging, definition of pixel and voxel, digital image processing, factors affecting image quality, imaging systems in NM: planar vs. tomographic scanners, image reconstruction, Anger-type cameras, PET and SPECT systems, types of collimators, solid-state cameras (CZT) and their advantages.

Radiochemistry: Radiopharmaceuticals for Measuring Blood Flow, Metabolism and Low-Capacity Biochemical Systems – Synthesis, QC, Kinetics and Radiopharmacology

Chemistry and common reactive reagents in various radiosyntheses (carbon-11, fluorine-18, iodine-124). Labeling of peptides, proteins and nanoparticles with radioactive metals: conditions and chelate reagents. QC approaches, requirements and characteristics of radiopharmaceuticals for measuring blood flow, metabolism, low-capacity systems and for radiotherapy.

Clinical and Preclinical Research Applications in Cardiology, Oncology and Neurology

Imaging myocardial perfusion (Tc-MIBI, Thallium, NH3, Rb and new fluorine-18 labeled agents). Metabolism measurements using FDG, radiolabeled amino acids and fatty acids. Proliferation measurements using choline and fluorothymidine.

Imaging low-capacity biochemical systems (enzyme and receptors): EGFR, dopamine receptors and the dopamine transporter, MAO-B, somatostatin receptor, VEGFR and integrins in angiogenesis. Applications of radiolabeled antibodies and nanoparticles and preclinical research imaging of small rodents.

Required Reading:

Additional Reading Material:

Course/Module evaluation:
End of year written/oral examination 100 %
Presentation 0 %
Participation in Tutorials 0 %
Project work 0 %
Assignments 0 %
Reports 0 %
Research project 0 %
Quizzes 0 %
Other 0 %

Additional information: