The Hashemite University
Faculty of Allied Health Sciences
Department of Medical Imaging
Course Syllabus

Course information	
Course Title	Molecular Imaging
Course Code	140508376
Prerequisites	140508324
Credit Hours	3 hours

Course Description

Molecular imaging is a term that is now used frequently to describe much of what nuclear medicine has been involved in for almost 50 years. Since the early attempts to produce images representing the spatial distribution of specific tissue and organ functions. The number of applications of molecular imaging therefore depends upon the radionuclides available, their inherent biochemistry whereby the radionuclide itself might be a useful tracer [such as an I-133 for assessment of thyroid function and imaging or F-18 as the fluoride to measure bone kinetics and skeletal imaging]. In addition, depending upon the chemistry of a particular element, the radiotracer may be useful to evaluate and image other molecular and physiologic processes if the radionuclide can either be incorporated into the native molecular structure of a compound

Course Objectives

By the end of this course, student is expected to:

1. Define Nuclear Transformation
2. Explain Methods of Radiolabeling
3. Compare between Radiotracer and Radiopharmaceutical
4. Discuss the Advantages of Organic Radionuclides
5. Describe the meyhod of synthesis of Radioiodinated Radiopharmaceuticals
6. Discuss the Tumor ImagingTime-domain systems
7. Explain Radiopharmaceuticals in Nuclear Cardiology

Recommended Textbook	
Title	Molecular Imaging Radiopharmaceuticals for PET and SPECT
Author	Shankar Vallabhajosula
Publisher	Springer Dordrecht Heidelberg London New York
Year	2009
Edition	1st Ed
Book website	

Other References	
Title	Nuclear Medicine and PET/CT: Technology and Techniques
Author	Paul E. Christian, Kristen M. Waterstram-Rich
Publisher	Elsevier Science
Year	2011
Edition	7th Ed.

Course Contents

Chapter 1: **Molecular Imaging: Introduction**

- Nuclear Medicine
- Molecular Medicine
- Molecular Imaging

Chapter 2: **Production of Radionuclides**

- Nuclear Transformation
- Nuclear Reactions
- Production of Radionuclides

Chapter 3: **Radiopharmaceuticals**

- Radiotracer Vs. Radiopharmaceutical
- Radiolabeled Molecular Imaging Probe
- Molecular Imaging Probe
- RMIPs: Categories and Types
- RMIP: Choice of Radionuclide
- General Criteria for the Design of RMIPs
- General Methods of Radiolabeling
- Automated Synthesis Modules .
- Microfluidic Systems

Chapter 4: **Chemistry of Radiohalogens (F, Br. and I)**

- Halogens
- Synthesis of ^{18}F labeled Radiopharmaceuticals
- Production of ^{18}F
- Nucleophilic Fluorination Reactions
- Electrophilic Fluorination Reactions
- Organic Precursors for ^{18}F Labeling
- Radiotracers Based on Nucleophilic Reactions
- Radiotracers Based on Electrophilic Reaction
- Synthesis of Radioiodinated Radiopharmaceuticals
- Production of ^{123}I and ^{124}I
- Chemistry of Iodine

Chapter 5: **Chemistry of Organic Radionuclides (C, N, and O)**

- Advantages of Organic Radionuclides
- ^{11}C Labeled Radiopharmaceuticals
- Production of ^{11}C
- ^{11}C Precursors
- Synthesis of ^{11}C Labeled MIPs
- ^{13}N Labeled Radiopharmaceuticals
- [^{13}N]Ammonia (NH3)
- Synthesis of [^{13}N]Gemcitabine
- ^{15}O labeled Radiotracers
- ^{15}O Labeled Gases
- Synthesis of [^{15}O]Water

Chapter 6: **Molecular Imaging in Oncology**

- Cancer
- Tumor Pathology and Biology
- Molecular Basis of Cancer
- Genetic Changes
- Tumor ImagingTime-domain systems
- Objectives
- Radiolabeled Molecular Imaging Probes:
- Biochemical Basis

Chapter 7: **Molecular Imaging in Cardiology**

- The Clinical Problem
- Pathophysiology
- Coronary Artery Disease
- Congestive Heart Failure
- Radiopharmaceuticals in Nuclear Cardiology
- Myocardial Blood Flow
- Myocardial Metabolism
- Myocardial Neuronal Imaging
- Angiogenesis

Assessment	
First Exam	25%
Second Exam	25%
Final Exam	50%