



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

<b>Course information</b>	
<b>Course Title</b>	Molecular Imaging
<b>Course Code</b>	140508376
<b>Prerequisites</b>	140508324
<b>Credit Hours</b>	3 hours
<b>Course Description</b>	
<p>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</p>	
<b>Course Objectives</b>	
By the end of this course, student is expected to:	
<ol style="list-style-type: none"> <li>1. Define Nuclear Transformation</li> <li>2. Explain Methods of Radiolabeling</li> <li>3. Compare between Radiotracer and Radiopharmaceutical</li> <li>4. Discuss the Advantages of Organic Radionuclides</li> <li>5. Describe the meyhod of synthesis of Radioiodinated Radiopharmaceuticals</li> <li>6. Discuss the Tumor ImagingTime-domain systems</li> <li>7. Explain Radiopharmaceuticals in Nuclear Cardiology</li> </ol>	
<b>Recommended Textbook</b>	
<b>Title</b>	Molecular Imaging Radiopharmaceuticals for PET and SPECT
<b>Author</b>	Shankar Vallabhajosula
<b>Publisher</b>	Springer Dordrecht Heidelberg London New York
<b>Year</b>	2009
<b>Edition</b>	1 <sup>st</sup> Ed
<b>Book website</b>	
<b>Other References</b>	
<b>Title</b>	Nuclear Medicine and PET/CT: Technology and Techniques
<b>Author</b>	Paul E. Christian, Kristen M. Waterstram-Rich
<b>Publisher</b>	Elsevier Science
<b>Year</b>	2011
<b>Edition</b>	7 <sup>th</sup> 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  $^{18}\text{F}$  labeled Radiopharmaceuticals
- Production of  $^{18}\text{F}$
- Nucleophilic Fluorination Reactions
- Electrophilic Fluorination Reactions
- Organic Precursors for  $^{18}\text{F}$  Labeling
- Radiotracers Based on Nucleophilic Reactions
- Radiotracers Based on Electrophilic Reaction
- Synthesis of Radioiodinated Radiopharmaceuticals
- Production of  $^{123}\text{I}$  and  $^{124}\text{I}$
- Chemistry of Iodine

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

- Advantages of Organic Radionuclides
- $^{11}\text{C}$  Labeled Radiopharmaceuticals
- Production of  $^{11}\text{C}$
- $^{11}\text{C}$  Precursors
- Synthesis of  $^{11}\text{C}$  Labeled MIPs
- $^{13}\text{N}$  Labeled Radiopharmaceuticals
- [ $^{13}\text{N}$ ]Ammonia ( $\text{NH}_3$ )
- Synthesis of [ $^{13}\text{N}$ ]Gemcitabine
- $^{15}\text{O}$  labeled Radiotracers
- $^{15}\text{O}$  Labeled Gases
- Synthesis of [ $^{15}\text{O}$ ]Water

## Chapter 6: Molecular Imaging in Oncology

- Cancer
- Tumor Pathology and Biology
- Molecular Basis of Cancer
- Genetic Changes
- Tumor Imaging
- 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%