Course Specification

RARD 526: Physics in Nuclear Medicine

Institution Name: Mahidol University

Campus/Faculty/Department: Faculty of Medicine Ramathibodi Hospital, Department of Diagnostic and Therapeutic Radiology

Section 1: General information

1. ***Course number and name***
   Course number: RARD 526
   Course name: Physics of Nuclear Medicine

2. ***Credits: 2(2-0-3)***

3. ***Curriculum and type of course***

   3.1 Curriculum: Physics of Nuclear Medicine

   3.2 Type of course: Required course

4. ***Instructors***
   4.1 Course Coordinator: Lect.Dr. Krisanat Chuamsaamarkkee
   4.2 Instructors
   Lect.Dr.Krisanat Chuamsaamarkkee
   Lect.Dr. Puthhiporn Charoenphun
   Lect. SasithornAmnuaywattakorn

5. ***Semester/Year:*** 2nd Semester, 1st year students
6. ***Pre-requisite:*** RARD 527 Medical Image Processing
   RARD 520 Radiation Biology
   RARD 526 Physics of Nuclear Medicine
7. ***Co-requisite:*** None
8. ***Classroom:*** To be announced
9. ***Revision Date:*** Nov 2019 ***By:*** Committee

Note: Revised course learning outcome, course description, and evaluation

Section 2: Purpose and objective

1. Course Learning Outcomes

2.1 Demonstrate an understanding of the radiation detection equipment (e.g. Ionisation Chamber, Proportional Counter, Scintillation Detector and Semiconductor Detector) for measuring unsealed radiation source withappropriated statistical methods

2.2 Have a comprehensive knowledge of the basic of imaging equipment in nuclear medicine and their quality control

2.3 Explain the basic principle of radionuclide production, mechanisms of radionuclide localization, the use and preparation of radiopharmaceuticals for both diagnostic and therapeutic applications and basic quality control of radiopharmaceuticals

2.4 Utilize basic internal dosimetry calculation method

2.5 Discuss the current and future roles of nuclear medicine in medical imaging

2.6 Effectively communicate and share the knowledge on medical physics in nuclear medicine by effective presentation skills

2.7 Be able to value the professional conduct, professional development in team working and leadership skills

Section 3: Course details

1. Course description

This course offers the introduction of various types of nuclear medicine counting equipment such as gas-filled detector, scintillation detector and semiconductor detector as well as using appropriated nuclear counting statistic method. Students will develop a beginning understanding of nuclear medicine equipment, imaging quality and image noise analysis in nuclear medicine. Explored in this course are the basic principles of non-imaging equipment in nuclear medicine, gamma camera, SPECT, PET, hybrid imaging (e.g. SPECT/CT and PET/CT) and BMD. This course examines radionuclide production, mechanisms of radionuclide localization the use and preparation of radiopharmaceuticals for both diagnostic and therapeutic applications and quality control of radiopharmaceuticals. This course also emphasizes on the dose calculation from internalized radionuclide with standard dosimetry method such as MIRD (Medical Internal Radiation Dose).

2. ***Hours per semester:*** Lecture 30 hours
3. ***Assignment feedback:*** Within 2 - 4 weeks

Section 4: Course Learning Outcomes

Course level learning outcomes	Program level learning outcomes	Methods	Assessment
1 Student can understand various types of radiation detection equipment for unsealed source with appropriated statistical methods	ELO 2	-Lecture -Demonstration	- Paper/oral Examination - Report/Assignment
2 Student can understand the basic principle of imaging equipment in nuclear medicine and also demonstrate, manage basic constancy tests, QC program and analyze the results with appropriate reaction	ELO 2	- Lecture - Demonstration - Experiment	- Paper/oral Examination - Report/Assignment
3 Student can explain the basic principle of radionuclide production, mechanisms of radionuclide localization the use and preparation of radiopharmaceuticals for both diagnostic and therapeutic applications and basic quality control of radiopharmaceuticals	ELO 2	- Lecture - Demonstration - Experiment	- Paper/oral Examination - Report/Assignment
4 Student can compute dose from internalized radionuclide with standard dosimetry method	ELO 2	- Lecture - Demonstration - Experiment	- Paper/oral Examination - Report/Assignment
5 Student can discuss the current and future roles of nuclear medicine in medical imaging	ELOs 2, 4	- Presentation	- Rubric Presentation Assessment

Course level learning outcomes	Program level learning outcomes	Methods	Assessment
6.Student can communicate and share the knowledge on medical physics in nuclear medicine by effective presentation skills	ELOs 2, 5	-Presentation - Assigned Reading	- Rubric Presentation Assessment
7.Student can value the professional conduct, professional development in team working and leadership skills	ELOs 1, 4	-Presentation - Group/Class Work	- Rubric Presentation Assessment - Group Assignment

Section 5: Lesson plan and assessment

1. Lesson plan

Time (h)	Topics	Instructors	Method	Assessment
2	Radiation Detection Equipment for Unsealed Source (1) - Gas Filled Detectors	Lect.Dr.Putthiporn	Lecture	Paper/Oral examination/Assignment
3	Radiation Detection Equipment for Unsealed Source (2) - Scintillation and Semiconductor Detector	Lect.Dr.Krisanat	Lecture	Paper/Oral examination/Assignment
1	Counting Statistic in Nuclear medicine	Lect.Dr.Krisanat	Lecture	Paper/Oral examination/Assignment
3	Introduction to Nuclear Medicine and Gamma Camera Basic Principle	Lect.Dr.Krisanat	Lecture	Paper/Oral examination/Assignment
3	Gamma Camera Performance Characteristic and QC	Lect.Dr.Krisanat	Lecture	Paper/Oral examination/Assignment
2	Tomographic Reconstruction in Nuclear Medicine	Lect.Dr.Krisanat	Lecture	Paper/Oral examination/Assignment
3	SPECT, SPECT/CT, Semiconductor SPECT - QC	Lect.Dr.Krisanat	Lecture	Paper/Oral examination/Assignment

Time (h)	Topics	Instructors	Method	Assessment
4	PET, PET/CT, PET/MRI - QC	Lect.Dr.Krisanat	Lecture	Paper/Oral examination/Assignment
2	Bone Mineral Densitometry	Lect.Sasithorn	Lecture	Paper/Oral examination/Assignment
2	Production of Radionuclide for Imaging and therapy	Lect.Dr. Putthiporn	Lecture	Paper/Oral examination/Assignment
2	Mechanism of Radiopharmaceutical localisation including clinical use, preparation, and QC	Lect.Dr.Putthiporn	Lecture	Paper/Oral examination/Assignment
3	Internal Dosimetry	Lect.Dr.Krisanat	Lecture	Paper/Oral examination/Assignment
	Students Journal presentations	All Lecturer	Assigned journal readings Class Discussion	Rubric presentation skill/Rubric assignment

Measurement and Evaluation of Student Achievement

2.1	Theory (short,long answer questions)	70%
2.2	Journal presentation	15%
2.3	Assignment	10%
2.4	Class discussion	5%

Section 6: Assessment and improvement of the course operation

1. Strategies to assess the effectiveness of the courses by the students
    - Assessment of instructor's teaching by student

2. Strategy to assess the instruction
    - Assessment of students' learning records
    - Assessment of instructor's teaching by student

3. Improvement of Instruction
    - Consider the students' learning records
    - Consider the students' assessment of instructor's teaching
    - Consider the program committee's comment

4. Verification of student achievement in the subject
    - By program committee and faculty-level academic committee

5. Review and action plan to improve the effectiveness of the course
    • Using the results from 1 - 4 as inputs to the instruction improvement

Learning Resources

1. Cherry, S.R., Sorenson, J.A. and Phelps, M.E., 2012. *Physics in Nuclear Medicine E-Book*. Elsevier Health Sciences.

2. De Lima, J.J. ed., 2016. *Nuclear medicine physics*. CRC Press.

3. Bailey, D.L., Huum, J.L., Todd-Pokropek, A. and Aswegen, A.V., 2014. *Nuclear medicine physics: a handbook for teachers and students*. Vienna: International Atomic Energy Agency (IAEA).