TEACHING INSTRUCTIONAL DESIGN (BRP)

COURSE

LABORATORY WORKS OF RADIOLOGY PHYSICS

by

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August 2016

PREFACE

This Teaching Instructional Design (BRP) was prepared as a guide for activities of Laboratory Works of Radiology Physics intended for 7th semester medical physics and biophysics elective physics students who have received the Introduction to Radiology Physics course and are studying medical imaging.

This course provides students with skills in the field of Diagnostic Radiology through experiments carried out using radiography and fluoroscopy x-ray, ultrasound machine, and nuclear medicine facilities. The learning method is designed in such way so that students are not only able to work independently, but can also work in groups, to understand the material comprehensively and integrally.

It is hoped that this book can provide guideline in the learning process so that all the targets expected by lecturers and students can be achieved.

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I. General Information

1.	Name of Program / Study Level	:	Physics / Undergraduate
2.	Course Name	:	Laboratory Works of Radiology Physics
3.	Course Code	:	SCFI604921
4.	Semester	:	7
5.	Credit(s)	:	1 Credits
6.	Teaching Methods(s)	:	Collaborative learning
7.	Prerequisite Course(s)	:	Introduction to Radiology Physics
8.	Requisite Course(s)	:	None
9.	Integration Between Other Courses	:	None
10.	Lecturer(s)	:	Supriyanto Ardjo Pawiro, Ph.D., Kristina Tri Wigati, M.Si.
11.	Course Description	:	Characteristic of radiodiagnostic film with respect to kV, mA, and time. Measurement of KERMA and its dependence to kV, mA, and time. HVL determination for radiology diagnostic use. Measurement of focal spot and beam alignment. Timer and kV accuracy of x-ray machine. This course will be taught in Indonesian.

II. Course Learning Outcome (CLO) and Sub-CLOs

A. CLO

Students will experiment on things related to radiology diagnostic physics at hospitals, quality assurance method, and dosimetry measurement (ELO(s) 3, 5, 6, 7, 8).

B. Sub-CLOs

1. Study the relationship between KERMA and mA/mAs, time, and filter on the radiodiagnostic x-ray.
2. Test the correctness and consistency of voltage and timing on radiodiagnostic x-ray.
3. Determine the Half Value Layer (HVL) of radiodiagnostic x-ray.
4. Study the effect of changes in kV, mA/mAs to the blackness of film with or without intensifying screen.
5. Test the correctness of the light beam against radiation and the alignment of the radiation beam.
6. Measure the effective focal spot of an x-ray machine.
7. Study the characteristics of radiodiagnostic film used in x-ray examination.
8. Study medical fluoroscopy imaging which consists of image quality assurance and dosimetry.
9. Conduct ultrasound image quality control which consist of uniformity, dead zone, penetration depth, beam profile, focal zone, lateral response, vertical and horizontal distance accuracy, axial and lateral resolution, anechoic mass, and contrast sensitivity.
10. Check the linearity of dose calibrator readings as a determinant for radiopharmaceutical dose used in nuclear medicine.
11. Test the relation between a dose calibrator to the sample geometry.
12. Test the intrinsic and extrinsic responses of a gamma camera toward a uniform spatial flux from photons captured in the field of view (FOV).
13. Test the intrinsic spatial resolution of a gamma camera in relation to FWHM for each line spread function.
14. Verify the effect of distance and rotation during scanning with SPECT mode toward scintillation events.

III. Teaching Plan

Week	Sub-CLO	Study Materials	Teaching Method	Time Required	Learning Experiences (*O-E-F)	Sub-CLO Weight on Course (%)	Sub-CLO Achievement Indicator	References
1-7	1-7	• Radiography	Collaborative learning	170 minutes each week	20% O, 60% E, 20% F	50	• Able to explain the relation between kV, mAs, and filter with KERMA. • Able to measure kVp and time in x-ray machine, Able to determine HVL. • Able to explain the relation between kV and mA. • Able to do quality assurance and check beam alignment. • Able to determine focal spot size and characteristic of x-ray film	[1], [2], [3], [4]
8	8	• Fluoroscopy	Collaborative learning	170 minutes	20% O, 60% E, 20% F	7.14	Able to explain medical imaging with fluoroscopy	[1], [2], [3], [4]

9	9	• Ultrasonography	Collaborative learning	170 minutes	20% O, 60% E, 20% F	7.14	Able to explain quality assurance of USG	[1], [2], [3], [4]
10-14	10-14	• Nuclear Medicine	Collaborative learning	170 minutes each week	20% O, 60% E, 20% F	35.72	Able to explain linearity and geometry assurance of dose calibrator. Able to test intrinsic and extrinsic uniformity. Able to measure spatial resolution with phantom. Able to measure center of rotation and SPECT mode in CT.	[1], [2], [3], [4]

*) O : Orientation
E : Exercise
F : Feedback

References:

1. J. T. Bushberg, J. A. Seibert, E. M. Leidhodt, Jr., J. M. Boone. The Essential Physics of Medical Imaging. 2nd ed., Williams and Wilkins, Baltimore, MD, 2002.
2. P.P Dendy and B. Heaton. Physics of Diagnostic Radiology, Institute of Physics Publishing, London, UK, 1999.
3. P. Sprawl. Physical Principles of Medical Imaging, Aspen Publishers,. Gaithersburg, Maryland, 1987.
4. Buku Panduan Praktikum Fisika Radiologi Diagnostik, Departemen Fisika FMIPA UI

IV. Assignment Design

Week	Assignment Name	Sub-CLOs	Assignment	Scope	Working Procedure	Deadline	Outcome
1-7	Group Assignment 1	1-4	Problem sets	• Radiography	Group Assignment	1 week	Presentation
1-7	Individual Assignment 1	1-7	Problem sets	• Radiography	Individual Assignment	1 week	Lab report
8	Group Assignment 2	1-7	Problem sets	• Fluoroscopy	Group Assignment	1 week	Presentation
8	Individual Assignment 2	8	Problem sets	• Fluoroscopy	Individual Assignment	1 week	Lab report
9	Group Assignment 3	8	Problem sets	• USG	Group Assignment	1 week	Presentation
9	Individual Assignment 3	9	Problem sets	• USG	Individual Assignment	1 week	Lab report
10-14	Group Assignment 4	9	Problem sets	• Nuclear Medicine	Group Assignment	1 week	Presentation
10-14	Individual Assignment 4	10-14	Problem sets	• Nuclear Medicine	Individual Assignment	1 week	Lab report
15	Laboratory Works Exam	1-14	Problem sets	• All study materials	Exam	100 minutes	Answer sheet

V. Assessment Criteria (Learning Outcome Evaluation)

Evaluation Type	Sub-CLOs	Assessment Type	Frequency	Evaluation Weight (%)
Quiz	1-14	Answer sheet	1 each week	20
Group Assignment	1-14	Presentation	1 each week	35
Individual Assignment	1-14	Lab report	1 each week	10
Exam	1-14	Answer sheet	1	35
Total				**100**

VI. Rubric(s)

A. Criteria of Individual Assignment

Score	Answer Quality
>90	Student able to answer 90% of the problem sets correctly

70-89	Student able to answer 70-89% of the problem sets correctly
60-69	Student able to answer 60-69% of the problem sets correctly
55-59	Student able to answer 55-59% of the problem sets correctly
50-54	Student able to answer 50-54% of the problem sets correctly
<50	Students able to answer <50% of the problem sets correctly

B. Criteria of Group Assignment

Score	Answer Quality
90-100	Students are able to apply basic concepts in explaining natural phenomena and technology with an accuracy of 80-90%, have a clear order, and appropriate wording.
70-89	Students are able to apply basic concepts in explaining natural phenomena and technology with an accuracy of 60-79% accuracy with appropriate wording.
60-69	Students are able to apply basic concepts in explaining natural phenomena and technology with an accuracy of 59% or less with appropriate wording.

C. Criteria of Presentation

Score	Answer Quality
90-100	Students are able to present their topic with correct language structure, easy to understand explanation, understand their topic well, and have good body language.
70-89	Students are able to present their topic with easy to understand explanation, understand their topic well, and have good body language.
60-69	Students are able to present their topic with easy to understand explanation and have good body language

D. Criteria of Quiz and Exam

1) Able to write down their ideas and use it to solve a problem (25%);

2) Able to use the correct concept in solving the problem (35%);

3) Able to formulate the final result correctly (30%);

4) Able to use the appropriate dimension, units, and significant figures (10%);