



TEACHING INSTRUCTIONAL DESIGN (BRP)

COURSE

INTRODUCTION TO RADIOLOGY PHYSICS AND DOSIMETRY

by

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UNIVERSITAS INDONESIA
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
PHYSICS UNDERGRADUATE STUDY PROGRAM

TEACHING INSTRUCTIONAL DESIGN

Course Name	Introduction to Radiology Physics and Dosimetry	Credit(s)	Prerequisite course(s)	Requisite for course(s)	Integration Between Other Courses
Course Code	SCPH603716	2	Modern Physics	Health Physics and Radiation Protection, Introduction to Medical Imaging and Nuclear Medicine, Introduction to Radiotherapy Physics	None
Relation to Curriculum	Elective				
Semester	6/7				
Lecturer(s)	Akbar Azzi, M.Si. Lukmanda Evan Lubis, M.Si.				
Course Description	This course teaches students about the principles of physics in the field of radiology and dosimetry. Starting with the quantities and units used in radiology, then the interaction of radiation with matter with a focus on energy transfer and dose deposition. The exponential attenuation for narrow and broad beam radiation should be understood by students before they learn about shielding design systems for both diagnostic and therapeutic rooms. The application of charged particle equilibrium and cavity theory underlies dosimetry using ionization chamber detectors. Furthermore, this course				

	also teaches the application of equilibrium in using ionization chamber as well as solid state detector. This course will be taught in Indonesian.
Program Learning Outcome (PLO)	
PLO 1	Applying concepts of medical physics and biophysics
PLO 2	Apply physics knowledge in communities and practical life, as well as identify and adapt to new things.
Course Learning Outcome (CLO)	
CLO 1	Students able to identify basic physics principle related to radiology and appropriate dosimeter according to international protocol.
Sub-CLO(s)	
Sub-CLO 1	Able to explain characteristics of radiation according to basic physics principle
Sub-CLO 2	Able to apply basic modern physics principle to interaction of radiation with matter problems.
Sub-CLO 3	Able to identify characteristics of radiation measurement in dosimetry
Sub-CLO 4	Able to illustrate and differentiate various dosimeter used for clinical situation.
Study Materials	
	<ol style="list-style-type: none"> 1. Classification of radiation 2. Radiation units and quantities 3. Interaction coefficients 4. Ionizing and non-ionizing radiation 5. Interaction of radiation with matter (photon) 6. Interaction of radiation with matter (electron) 7. Radioactive decay 8. Charged Particle Equilibrium 9. Radiation dosimetry 10. Cavity Theory 11. Ionization chamber 12. Photon and electron calibration with ionization chamber

	<p>13. Clinical dosimetry protocol: radiotherapy 14. Clinical dosimetry protocol: radiology diagnostic and interventional 15. Absolute and relative dosimetry technique</p>
<p>Reading List</p>	<p>1. Podgorsak, Radiation Oncology Physics: Handbook for Teacher and Student. (IAEA, 2005) 2. F. H. Attix. Introduction of Radiological Physics and Radiation Dosimetry (John Willey and Sons, New York, NY, 1986) 3. Dance, Diagnostic Radiology Physics: A Handbook for Teachers and Students. (IAEA, 2010) 4. Metcalfe, et al, The Physics of Radiotherapy X-rays and Electron. (Medical Physics Publishing, 2007) 5. H. E. Johns and J. R. Cunningham. The Physics of Radiology, 4th ed. (Charles C. Thomas, Springfield, IL, 1983) 6. J. F. Knoll. Radiation Detection and Measurement. 3rd. ed. (John Willey and Sons, New York, NY, 2000). 7. AAPM TG-21, AAPM TG-51, IAEA TRS 277, IAEA TRS 398, IAEA TRS 457, and ICRU Report 74</p>

I. Teaching Plan

Week	Sub-CLO	Study Materials [with reference]	Teaching Method [with est. time]	Learning Experiences (*O- E-F)	Sub-CLO Achievement Indicator		Sub- CLO Weight on Course (%)
					General	Specific	
1	Introduction to course						
2-4	1	<ol style="list-style-type: none"> 1. Classification of radiation 2. Radiation units and quantities 3. Exponential attenuation 4. Ionizing and non-ionizing radiation <p>References: [1]-[3]</p>	<p>Asynchronous: Lecture videos 3x1 Week</p> <p>Synchronous: Discussion through msTeams/Gmeet at week 4 100 minutes</p>	<p>Orientation: Watching lecture video and reading references (25%)</p> <p>Exercise: Pretest, quiz, summary assignment, discussion (40%)</p> <p>Feedback: Question and answer with lecturer (35%)</p>	Able to explain modern physics concepts in radiology	Able to differentiate types of radiation as well as the units and quantities used	25%
5-7	2	<ol style="list-style-type: none"> 1. Interaction of radiation with matter (photon) 2. Interaction of radiation with matter (electron) 3. Radioactive decay 4. Charged Particle 	<p>Asynchronous: Lecture videos 3x1 Week</p> <p>Synchronous: Discussion through msTeams/Gmeet at week 7</p>	<p>Orientation: Watching lecture video and reading references (25%)</p> <p>Exercise: Pretest, quiz,</p>	Able to apply modern physics concept to interaction of radiation with matter	Able to explain the process of interaction of radioactive source with matter as well as its relation to the classification of radiation. Furthermore, able to differentiate between artificial or natural radiation	25%

		Equilibrium References: [1] & [2]	100 minutes	summary assignment, discussion (40%) Feedback: Question and answer with lecturer (35%)			
8	Mid-Term Exam						
9-11	3	<ol style="list-style-type: none"> Radiation dosimetry Cavity Theory Ionization chamber Photon and electron calibration with ionization chamber References: [1] & [2]	Asynchronous: Lecture videos 3x1 Week Synchronous: Discussion through msTeams/Gmeet at week 11 100 minutes	Orientation: Watching lecture video and reading references (25%) Exercise: Pretest, quiz, summary assignment, discussion (40%) Feedback: Question and answer with lecturer (35%)	Able to characterize detector used in radiation dose measurement	Able to analyze physical characteristic of a detector especially gas-filled detector for photon and electron dose measurement	25%
12-15	4	<ol style="list-style-type: none"> Clinical dosimetry protocol: radiotherapy Clinical dosimetry protocol: radiology 	Asynchronous: Lecture videos 4x1 Week Synchronous:	Orientation: Watching lecture video and reading references (16.67%)	Able to differentiate dosimeter used in radiology diagnostic and interventional as well as in	Able to classify dosimeter according to physics principle and measurement method	25%

		<p>diagnostic and interventional</p> <p>3. Absolute and relative dosimetry technique</p> <p>References: [1] & [7]</p>	<p>Discussion & presentation through msTeams/Gmeet at week 14 & 15</p> <p>100 minutes</p>	<p>Exercise: Pretest, quiz, summary assignment, discussion, presentation (43.33%)</p> <p>Feedback: Question and answer with lecturer related to material, presentation, and discussion (40%)</p>	radiotherapy		
16	Final Exam						

II. Assignment Design

Week	Assignment Name	Sub-CLOs	Assignment	Scope	Working Procedure	Deadline	Outcome
4	Material Summary	1	Write essay	Material in week 1-4	Individual Assignment	1 week	Essay about material summary, minimum 5 pages
7	Material Summary	2	Write essay	Material in week 5-8	Individual Assignment	1 week	Essay about material summary, minimum 5 pages
7	Video Presentation	4	Presentation in video form	<ol style="list-style-type: none"> 1. Ionization chamber 2. TLD 3. Radiochromic film 4. Optically stimulated luminescence 5. Diode and MOSFET dosimeter 6. Diamond dosimeter 7. Gel dosimeter 8. Geiger-Muller and proportional dosimeter 9. Scintillation dosimeter 10. Neuron detector 	Group Assignment	7 weeks	Video about dosimeter characterization
11	Material Summary	3	Write essay	Material in week 9-12	Individual Assignment	1 week	Essay about material summary, minimum 5 pages
14	Material Summary	4	Write essay	Material in week 13-15	Individual Assignment	1 week	Essay about material summary, minimum 5 pages

III. Assessment Criteria (Learning Outcome Evaluation)

Evaluation Type	Sub-CLO	Assessment Type	Frequency	Evaluation Weight (%)
Pretest & Quiz	1-4	True/False Question	14	-
Module Exam	1-4	Multiple Choice	4	40
Summary	1-4	Essay/Scientific Paper	4	15
Video	4	Video Presentation	1	15
Mid-Term Exam	1-2	Essay	1	15
Final Exam	3-4	Essay	1	15
Total:				100%

IV. Rubric(s)

This rubric is used as a guideline for assessing or giving levels of student performance results. a rubric usually consists of assessment criteria that include the dimensions / aspects that are assessed based on indicators of learning achievement. This assessment rubric is useful for clarifying the basics and aspects of the assessment so that students and lecturers can be guided by the same thing regarding the expected performance demands. Lecturers can choose the type of rubric according to the assessment given.

A. Conversion of the student's final score

Score	Grade	Equivalent
85 - 100	A	4.00
80 - < 85	A-	3.70
75 - < 80	B+	3.30
70 - < 75	B	3.00
65 - < 70	B-	2.70
60 - < 65	C+	2.30
55 - < 60	C	2.00
40 - < 50	D	1.00
< 40	E	0.00

B. Assessment rubric: project report and papers

Rubric 1 (Summary)

Criteria	A (90)	B (75)	C (60)	D (50)
Organization (Order, flow, and transition)	Information is presented in an effective order. The excellent structure of paragraphs and transitions improves readability and comprehension. The executive summary or abstract is presented first, allowing the reader to easily follow the rest of the report.	Information is logically ordered by paragraphs and transitions. Within sections, the order in which ideas are presented may be confusing at times.	Information is scattered and needs further development.	There is no clear sequence of paragraphs, so there is no progressive flow of ideas. The details and examples are disorganized, difficult to follow or understand.

Information Quality	Supporting details are specific to the topic and provide the necessary information.	Some details do not support the topic of the report.	Details are a bit vague.	No details on the information given.
Introduction	Paragraph is clearly stated, has a sharp focus, and increases the impact of the report.	Paragraph is clearly stated.	Paragraph is not structured correctly.	Paragraph is unclear and vague.
Conclusion	Paragraphs summarize concisely and draw a clear and effective conclusion that increase the impact of the report.	Paragraphs summarize the entire topic concisely.	Paragraphs does not draw the correct conclusion.	Paragraph is unclear and vague
Use of language: words choice, grammar, and sentence structure	Sentences are complete, grammatical, and flow together easily. The word is chosen for its proper meaning.	Most sentences are complete, grammatical, and flow together. Mistakes are minor and does not distract reader.	Minor mistakes in sentence structure and grammar are frequent. Unnecessary repetition of words and phrases.	Major mistakes in sentence structure and grammar. Frequent repetition of words and phrases.
Use of pictures: numbers, graphs & images	All numbers, graphics and images used are accurate, consistent with text, and of good quality. Appropriate and consistent labeling.	Most numbers, graphics, and images used are accurate. A few inconsistencies in labeling.	Some inaccurate graphics and images are used. Labeling is not consistent.	Numbers, graphs, and images used are not accurate, bad quality, and not properly labeled.

Rubric 2 (Video Presentation)

Criteria	A (90)	B (75)	C (60)	D (50)
Organization (Order, flow, and transition)	Presentation have ordered flow of information, easy to follow and understandable.	Presentation have ordered flow of information, easy to follow and somewhat understandable.	No order in flow of information but still easy to follow and somewhat understandable.	No order in flow of information and hard to follow or understand
Information Quality	Information is detailed and complete and accompanied by examples	Information is less detailed but still accompanied by examples	Information is not detailed and no examples	Information is not related to topic given
Analysis and Conclusion	Analysis and conclusion exist	Analysis exists but not in-depth. Conclusions exist	Analysis is not detailed but conclusions still exist	No analysis or conclusions
Voice and Communication	Grammar and vocabulary are correct. Sentences are systematic. Voice is clear.	Grammar and vocabulary are correct. Voice is clear.	Use easy-to-understand sentences. Voice is not clear.	Use hard-to-understand sentences. Voice is not clear.
Video Technique	Editing is interesting. Pictures and illustrations is enticing.	Video is not monotone. Pictures and illustrations exist.	Video is monotone and no pictures or illustrations.	Only voice-over.

Rubric 3 (Mid-Term Exam and Final 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%);