PORTFOLIO FOR
NUCLEAR PHYSICS COURSE

SEMESTER 7 ACADEMIC YEAR 2020-2021

Course Coordinator:
Prof. Tjipto Prastowo, Ph.D

Teaching Team:
Prof. Dr. Wasis, M.Si
Mita Anggaryani, Ph.D
Lydia Rohmawati, S.Si., M.Si

PHYSICS DEPARTMENT
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
THE STATE UNIVERSITY OF SURABAYA
2021

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A. SEMESTER LEARNING ACTIVITY PLAN

A.1 COURSE IDENTITY

Module Name	Nuclear Physics
Module Level	Bachelor Degree
Course Code	N/A
Subheading	N/A
Course contained	N/A
Semester/Year	7/4
Module Coordinator	Prof. Tjipto Prastowo, Ph.D
Lecturers	1. Prof. Tjipto Prastowo, Ph.D 2. Prof. Dr. Wasis, M.Si 3. Mita Anggaryani, Ph.D 4. Lydia Rohmawati, S.Si., M.Si
Language	Bahasa Indonesia
Course Classification	Compulsory
Teaching format/ The number of hours per week during semester	A weekly meeting in class for 3 'hours' of teaching (1 'hour' of teaching = 50 minutes)
Course Load	1 Course Unit = 3 workhours per week or 170 minutes per week with various activities as follows: • Class Activity: 50 minutes • Structured Learning: 60 minutes • Independent Learning: 60 minutes **3 Course Units = 9 workhours per week = 510 minutes per week**
Course Credit	3 Course Units
Pre-requisites	Quantum Physics, Statistical Physics
Course Learning Outcome	1. Demonstrating independent, creative and honest characters in doing student assignments, mid and final exams. 2. Understanding structured concepts of the nucleus of an atom in many aspects from the history of nuclear discovery to possible applications of nuclear technology and energy, and its corresponding nuclear waste management. 3. Understanding different perspectives of a nuclear power plant and the search for alternative energy based on nuclear reaction. 4. Understanding poster creation with relevant themes of radioisotope decay for various applications in human life.
Course Content	Nuclear Physics examines the discovery of the nucleus of an atom, nuclear properties in general, nuclear stability and binding energy per nucleon, deutron as the simplest nucleus, energy levels of nucleus, nuclear models, radioactive decay, mechanisms of nuclear decay, Q-value

	calculation for nuclear reaction, building bloks of matter, families of elementary particles, fundamental conservation laws in nuclear reaction, the existence of meson, nuclear fission and fusion, alternative green energy based on hydrogen fusion, nuclear technology, a nuclear power plant and its corresponding nuclear waste management, and radioactive decay for various applications in human life.
Attributed soft skill	1. Oral communication skills in individual presentation 2. Collaborative work in a group of students
References and sources	1. Prastowo, T. 2015. *Lecture Notes on Nuclear Physics.* Unpublished work. 2. Abdullah, K. M. S. 2014. *Fundamentals of Nuclear Physics*. Kurdistan Region, Iraq: University of Duhok Publication. 3. Bortz, A. B. 2007. *Physics: decade by decade*. New York, US: Facts on File Inc. 4. Serway, R. A., Moses, C. J., and Moyer, C. A. 2005. *Modern Physics*. Belmont, US: Thomson Brooks/Cole. 5. Beiser, A. 2003. *Concepts of Modern Physics*. New York, US: McGraw-Hill Companies 6. Some power point files and/or course materials relevant to Nuclear Physics from the internet.

A.2 COURSE TOPICS

Class discussions involve the following learning materials:

1. The history of nuclear discovery: nuclear discovery, terminologies and measurements of atomic scales, classicification of a nuclide, fundamental interaction.
2. Nuclear properties: static and dynamic properties, nuclear stability, proton-neutron configuration for stable nuclei.
3. Differences between atom and nucleus: atomic structure versus nuclear structure, hydrogen and deutron, energy levels in atoms and nuclei, spin and parity for nucleus.
4. Nuclear models: Fermi model, liquid-drop model, shell model, magic numbers, nuclear valence.
5. Radioactive decay: radioactive decay, mechanisms of radioactive decay, charge conservation, Q-value calculation, alpha decay, beta decay, electron capture, gamma decay.
6. Building blocks of matter: classification of elementary particles, quarks and leptons, bosons and fermions, hadrons and leptons, particle and anti-particle, standard model, fundamental conservation laws in nuclear reaction.
7. The discovery of meson: Yukawa hypothesis, pion properties, positive, negaitve, and neutral pions, nuclear reaction that involves pions.
8. Nuclear reaction: nuclear fission and fusion, a nuclear power plant and its corresponding nuclear waste management, alternative energy based on nuclear reaction, radioactive decay for various applications in human life.
9. Posters and video clips presentation on nuclear technology and its potential use for various benefits to human life.

A.3 COURSE PROGRAM

	THE STATE UNIVERSITY OF SURABAYA **FACULTY OF MATHEMATICS AND NATURAL SCIENCES** **PHYSICS STUDY PROGRAM**	**Document Code**

SEMESTER LESSON PLAN

NAME OF COURSE	**COURSE CODE**	**DISCIPLINE**	**COURSE UNIT**		**SEMESTER**	**DATE CREATED**
NUCLEAR PHYSICS		PHYSICS	**T= 3 units**	**P=?**	7 (seven)	2 August 2020

AUTHORISATION	**AUTHOR**	**COURSE COORDINATOR**	**HEAD OF PHYSICS STUDY PROGRAM**
PHYSICS DEPARTMENT	Prof. Tjipto Prastowo, Ph.D	Prof. Dr. Wasis, M.Si	Prof. Dr. Munasir, M.Si

Learning Achievement		
	Program Learning Outcome (PLO)	
	PLO1	Students are able to demonstrate knowledge of Classical Physics and Modern Physics.
	PLO6	Students are able to improve their knowledge and continue their study in a higher education.
	PLO7	Students are able to communicate their ideas and/or research results through academic writing and speaking effectively.
	PLO9	Students are able to work as an individual as well as a team effectively, have entrepreneurship skill and awareness of environmental issues
	PLO10	Students are able to demonstrate good scientist's manners, critical thinking and innovation skills in research and professional fields, and willing to do lifelong learning
	Course Learning Outcome (CLO)	
	CLO-1	Demonstrating independent, creative and honest characters in doing student assignments, mid and final exams.
	CLO-2	Understanding structured concepts of the nucleus of an atom in many aspects from the history of nuclear discovery to possible applications of nuclear technology and energy, and its corresponding nuclear waste management.
	CLO-3	Understanding different perspectives of a nuclear power plant and the search for alternative energy based on nuclear reaction.
	CLO-4	Understanding poster creation with relevant themes of radioisotope decay for various applications in human life.
	Final competence in each step of learning (Sub-CLO)	
	Sub-CLO1	Being able to understand the history of nuclear discovery in the context of modern physics, classification of a nuclide based on a specific number of protons and neutrons, and the dominant interaction within the nucleus.
	Sub-CLO2	Being able to understand nuclear properties in general, the nature of nucleus based on its proton-neutron configuration that leads to stable and unstable nuclei, nuclear characteristics based on binding energy per nucleon, and concepts and measurement

		techniques of isotope determination.
	Sub-CLO3	Being able to understand differences between hydrogen and deutron, energy levels of nucleus, nuclear interaction involved, and nuclear characteristics based on its corresponding spin and parity.
	Sub-CLO4	Being able to understand nuclear models and the roles of nuclear valence in controlling nuclear properties.
	Sub-CLO5	Being able to understand concepts of stable nuclei and radioactive nuclei, mechanisms of radioactive decay and its corresponding fundamental principles of electric charge and mass-energy conservation.
	Sub-CLO6	Being able to understand concepts of elementary particles, classification of elementary particles, 'everything is made in pairs', and fundamental conservation laws.
	Sub-CLO7	Being able to understand the discovery of meson as a carrier between nucleons, types of meson, and nuclear reaction that involves meson, meson resonance.
	Sub-CLO8	Being able to understand differences between nuclear fission and fusion, potential sources of alternative green energy based on hydrogen fusion, radioactive decay for various applications in human life, nuclear technology, and a nuclear power plant and its corresponding nuclear waste management.
	Sub-CLO9	Being able to understand some issues associated with nuclear technology and its potential use for various benefits to human life through poster creation by a group of students and individual poster presentation.
Course Description	Nuclear Physics examines the discovery of the nucleus of an atom, nuclear properties in general, nuclear stability and binding energy per nucleon, deutron as the simplest nucleus, energy levels of nucleus, nuclear models, radioactive decay, mechanisms of nuclear decay, Q-value calculation for nuclear reaction, building bloks of matter, families of elementary particles, fundamental conservation laws in nuclear reaction, the existence of meson, nuclear fission and fusion, alternative green energy based on hydrogen fusion, nuclear technology, a nuclear power plant and its corresponding nuclear waste management, and radioactive decay for various applications in human life.	
Topic Discussions: Learning Materials	1. The history of nuclear discovery: nuclear discovery, terminologies and measurements of atomic scales, classicification of a nuclide, fundamental interaction. 2. Nuclear properties: static and dynamic properties, nuclear stability, proton-neutron configuration for stable nuclei. 3. Differences between atom and nucleus: atomic structure versus nuclear structure, hydrogen and deutron, energy levels in atoms and nuclei, spin and parity for nucleus. 4. Nuclear models: Fermi model, liquid-drop model, shell model, magic numbers, nuclear valence. 5. Radioactive decay: radioactive decay, mechanisms of radioactive decay, charge conservation, Q-value calculation, alpha decay, beta decay, electron capture, gamma decay 6. Building blocks of matter: classification of elementary particles, quarks and leptons, bosons and fermions, hadrons and leptons, particle and anti-particle, standard model, fundamental conservation laws in nuclear reaction. 7. The discovery of meson: Yukawa hypothesis, pion properties, positive, negaitve, and neutral pions, nuclear reaction that involves pions. 8. Nuclear reaction: nuclear fission and fusion, a nuclear power plant and its corresponding nuclear waste management, alternative energy based on nuclear reaction, radioactive decay for various applications in human life. 9. Posters and video clips presentation on nuclear technology and its potential use for various benefits to human life.	

References	**Primary:**
	1. Prastowo, T. 2015. *Lecture Notes on Nuclear Physics.* Unpublished work. 2. Abdullah, K. M. S. 2014. *Fundamentals of Nuclear Physics*. Kurdistan Region, Iraq: University of Duhok Publication. 3. Bortz, A. B. 2007. *Physics: decade by decade*. New York, US: Facts on File Inc. 4. Serway, R. A., Moses, C. J., and Moyer, C. A. 2005. *Modern Physics*. Belmont, US: Thomson Brooks/Cole. 5. Beiser, A. 2003. *Concepts of Modern Physics*. New York, US: McGraw-Hill Companies
	Secondary:
	Some power point files and/or course materials relevant to Nuclear Physics from the internet
Lecturers	Prof. Tjipto Prastowo, Ph.D, Prof. Dr. Wasis, M.Si., Mita Anggaryani, Ph.D., Lydia Rohmawati, S.Si., M.Si.
Pre-requisites	Quantum Physics, Statistical Physics

Week	**Final competence in each learning step (Sub-CLO)**	**Assessment**		**Learning Format, Methods, Instruction, (Time Allocation)**		**Learning Materials**	**Proportion (%)**
		Indicator	**Criteria & Format**	**Luring (*offline*)**	**Daring (*online*)**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
1	Being able to understand the history of nuclear discovery in the context of modern physics, classification of a nuclide based on a specific number of protons and neutrons, and the dominant interaction within the nucleus	Students can explain the history of nuclear discovery in the context of modern physics, classification of a nuclide based on a specific number of protons and neutrons, and the dominant interaction within the nucleus			Contextual Learning Class discussion Q & A	• Nuclear discovery • Terminologies and measurements of atomic scales • Mass-energy equivalence • Classicification of a nuclide • Fundamental interaction • Gravity • Weak interaction • Electromagnetic interaction • Strong interaction	

2	Being able to understand nuclear properties in general, the nature of nucleus based on its proton-neutron configuration that leads to stable and unstable nuclei, nuclear characteristics based on binding energy per nucleon, and concepts and measurement techniques of isotope determination	Students can explain nuclear properties in general, the nature of nucleus based on its proton-neutron configuration that leads to stable and unstable nuclei, nuclear characteristics based on binding energy per nucleon, and concepts and measurement techniques of isotope determination			Contextual Learning Class discussion Q & A	• Nuclear properties • Nuclear radius • Nuclear density • Nuclear mass • Stable nuclei • Unstable nuclei • Nuclear stability • Binding energy • Proton and neutron separation energies • Mass spectroscope	
3	Being able to understand nuclear properties in general, the nature of nucleus based on its proton-neutron configuration that leads to stable and unstable nuclei, nuclear characteristics based on binding energy per nucleon, and concepts and measurement techniques of	Students can explain nuclear properties in general, the nature of nucleus based on its proton-neutron configuration that leads to stable and	Description on student assignments: 1. Short article (by a group) describing the use of radioactive decay and/or nuclear technology for various applications in human life 2. Corresponding		Contextual Learning Class discussion Q & A	• Nuclear properties • Nuclear radius • Nuclear density • Nuclear mass • Stable nuclei • Unstable nuclei • Nuclear stability • Binding energy • Proton and neutron separation	

	isotope determination	unstable nuclei, nuclear characteristics based on binding energy per nucleon, and concepts and measurement techniques of isotope determination	poster (by a group) 3. Individual poster presentation			energies • Mass spectroscope	
4	Being able to understand differences between hydrogen and deutron, energy levels of nucleus, nuclear interaction involved, and nuclear characteristics based on its corresponding spin and parity	Students can explain differences between hydrogen and deutron, energy levels of nucleus, nuclear interaction involved, and nuclear characteristics based on its corresponding spin and parity			Contextual Learning Class discussion Q & A	• Hydrogen, the simplest atom • Deutron, the simplest nucleus • Energy levels of an atom • Energy levels of nucleus • Nuclear force • Binding energy of a deutron • Spin and parity of a deutron	
5	Being able to understand nuclear models and the roles of nuclear valence in controlling nuclear properties	Students can explain nuclear models and the roles of nuclear valence in controlling nuclear			Contextual Learning Class discussion Q & A	• Nuclear models • Fermi model • Liquid-drop model • Shell model • Magic numbers • Nuclear valence	

		properties					
6	Being able to understand concepts of stable nuclei and radioactive nuclei, mechanisms of radioactive decay and its corresponding fundamental principles of electric charge and mass-energy conservation	Students can explain concepts of stable nuclei and radioactive nuclei, mechanisms of radioactive decay and its corresponding fundamental principles of electric charge and mass-energy conservation			Contextual Learning Class discussion Q & A	• Radioactive decay • Mechanisms of radioactive decay • Charge conservation • Q-value calculation • Alpha decay • Beta decay • Electron capture • Gamma decay	
7	Being able to understand concepts of stable nuclei and radioactive nuclei, mechanisms of radioactive decay and its corresponding fundamental principles of electric charge and mass-energy conservation	Students can explain concepts of stable nuclei and radioactive nuclei, mechanisms of radioactive decay and its corresponding fundamental principles of electric charge and mass-energy conservation	Student assignment 1 (short article): handed in Criteria for assessment are available		Contextual Learning Class discussion Q & A	• Radioactive decay • Mechanisms of radioactive decay • Charge conservation • Q-value calculation • Alpha decay • Beta decay • Electron capture • Gamma decay	**15%**
8	**Mid Semester Exam**						**30%**

9	Being able to understand concepts of elementary particles, classification of elementary particles, 'everything is made in pairs', and fundamental conservation laws	Students can explain concepts of elementary particles, classification of elementary particles, 'everything is made in pairs', and fundamental conservation laws			Contextual Learning Class discussion Q & A	• Building bloks of matter • Classification of elementary particles • Quarks and leptons • Bosons and fermions • Hadrons and leptons • Particle and anti-particle • Standard model • Fundamental conservation laws in nuclear reaction	
10	Being able to understand concepts of elementary particles, classification of elementary particles, 'everything is made in pairs', and fundamental conservation laws	Students can explain concepts of elementary particles, classification of elementary particles, 'everything is made in pairs', and fundamental conservation laws	Student assignment 2 (relevant posters): handed in Criteria for assessment are available		Contextual Learning Class discussion Q & A	• Building bloks of matter • Classification of elementary particles • Quarks and leptons • Bosons and fermions • Hadrons and leptons • Particle and anti-particle • Standard model • Fundamental conservation laws in nuclear reaction	**15%**

11	Being able to understand the discovery of meson as a carrier between nucleons, types of meson, and nuclear reaction that involves meson, meson resonance	Students can explain the discovery of meson as a carrier between nucleons, types of meson, and nuclear reaction that involves meson, meson resonance			Contextual Learning Class discussion Q & A	• The discovery of meson • Yukawa hypothesis • Pion properties • Positive, negative and neutral pions • Nuclear reaction that involves pions • Meson resonance	
12	Being able to understand differences between nuclear fission and fusion, potential sources of alternative green energy based on hydrogen fusion, radioactive decay for various applications in human life, nuclear technology, and a nuclear power plant and its corresponding nuclear waste management	Students can explain differences between nuclear fission and fusion, potential sources of alternative green energy based on hydrogen fusion, radioactive decay for various applications in human life, nuclear technology, and a nuclear power plant and its			Contextual Learning Class discussion Q & A	• Nuclear fission and fusion • A nuclear power plant and its corresponding nuclear waste management • Alternative energy based on nuclear reaction • Radioactive decay for various applications in human life	

		corresponding nuclear waste management					
13	Being able to understand differences between nuclear fission and fusion, potential sources of alternative green energy based on hydrogen fusion, radioactive decay for various applications in human life, nuclear technology, and a nuclear power plant and its corresponding nuclear waste management	Students can explain differences between nuclear fission and fusion, potential sources of alternative green energy based on hydrogen fusion, radioactive decay for various applications in human life, nuclear technology, and a nuclear power plant and its corresponding nuclear waste management			Contextual Learning Class discussion Q & A	• Nuclear fission and fusion • A nuclear power plant and its corresponding nuclear waste management • Alternative energy based on nuclear reaction • Radioactive decay for various applications in human life	
14	Being able to understand some issues associated with nuclear technology and its potential use for various benefits to human life	Students can present posters describing some issues associated with	Student assignment 3 (relevant clips): handed in Criteria for		Poster Presentation for Project-Based Learning Discussion Q & A	Poster Presentation on Nuclear Physics (with students being active for class presentation)	

	through poster creation by a group of students and individual poster presentation	nuclear technology and its potential use for various benefits to human life through poster creation by a group of students and individual poster presentation	assessment are available				
15	Being able to understand some issues associated with nuclear technology and its potential use for various benefits to human life through poster creation by a group of students and individual poster presentation	Students can present posters describing some issues associated with nuclear technology and its potential use for various benefits to human life through poster creation by a group of students and individual poster presentation	Student assignment 3 (relevant clips): handed in Criteria for assessment are available		Poster Presentation for Project-Based Learning Discussion Q & A	Poster Presentation on Nuclear Physics (with students being active for class presentation)	
16	**Final Exam**						**40%**

A.4 MAPPING OF LEARNING OUTCOME-COURSE OUTCOME

A.4.1 Program Learning Outcome (PLO) of UPP

Competency of SSC-ASIIN	Component	Code	Programme Learning Outcome (PLO)
Specific competences	**Knowledge**	KNO-1 (PLO1)	Able to **demonstrate** knowledge of Classical Physics and Modern Physics
		KNO-2 (PLO2)	Able to **formulate** a physical systems as physical model by using mathematics
		KNO-3 (PLO3)	Able to **solve problems** in physical systems comprehensively by using mathematics and computational tools
	Skill	SKI-1 (PLO4)	Able to **analyze** a physical system by applying mathematics and computational tools/ICT
		SKI-2 (PLO5)	Able to **design and conduct** experiments in learning physics by applying the scientific methods
		SKI-3 (PLO6)	Able to **improve their knowledge** and be able to continue their study in a higher education
		SKI-4 (PLO7)	Able to **communicate** their ideas and/or research results in academic writing and speaking effectively
Social and attitude competences	**Social**	SOC-1 (PLO8)	Able to **make a decision** based on the data and information in order to fulfil and evaluate their task responsibility
		SOC-2 (PLO9)	Able to **work as an individual as well as a team** effectively, **have entrepreneurship skill** and awareness of environmental issues
	Attitude	ATT-1 (PLO10)	Able to **demonstrate good scientist's manners**, critical thinking and innovation skills in research and professional fields; and willing to do lifelong learning
		ATT-2 (PLO11)	Able to **demonstrate the appreciation** of **religious values, and nationalism as citizens** as well as conducting their tasks professionally

A.4.2 Program Educational Objective (PEO) of UPP

1. Produce Bachelor of Physics who are able to use physics knowledge and methodology to solve problems in their work field.
2. Produce Bachelor of Physics who have a strong commitment to developing knowledge, whether by studying in a higher-level degree working in a formal institution and entrepreneurs.
3. Produce Bachelor of Physics who master the scientific method to observe, analyze and understand physical phenomena, and produce scientific work and contribute according to their expertise.
4. Produce Bachelor of Physics who masteries physics that is able to apply their knowledge, expertise in various fields of work, and develop themselves in their career environment.
5. Produce Bachelor of Physics who can communicate orally and/ in writing effectively, creatively, innovatively, and collaboratively, as well as working in teams.

A.4.3 Mapping of PLO-PEO

Outcomes	**Objectives**				
	Produce Bachelor of Physics who are able to use physics knowledge and methodology to solve problems in their work field.	Produce Bachelor of Physics who have a strong commitment to developing knowledge, whether by studying in a higher-level degree working in a formal institution and entrepreneurs.	Produce Bachelor of Physics who master the scientific method to observe, analyze and understand physical phenomena, and produce scientific work and contribute according to their expertise.	Produce Bachelor of Physics who masteries physics that is able to apply their knowledge, expertise in various fields of work, and develop themselves in their career environment.	Produce Bachelor of Physics who can communicate orally and/ in writing effectively, creatively, innovatively, and collaboratively, as well as working in teams.
PLO-1	S	S	S	S	S
PLO-2	S	S	S	S	S
PLO-3	S	S	S	S	S
PLO-4	S	S	S	S	S
PLO-5	S	M	S	M	S
PLO-6	S	M	S	S	M
PLO-7	S	S	S	M	S
PLO-8	S	M	S	M	S
PLO-9	S	M	S	M	S
PLO-10	M	M	M	M	S
PLO-11	M	M	M	S	S

Notes:

S = Strong, M = Moderate, L = Low

B. COURSE ASSESSMENT

B.1 ASSESSMENT RUBRICS

Notice that evaluation of student performances is taken from three student assignments, including a short article (assignment 1), a thematic poster (assignment 2), and an individual presentation (assignment 3), mid and final exams. These student assignments are assessed using the separate rubric for each.

The following rubric is used for assessing student assignment 1.

No	Aspects of Assessment	Scoring Scale			
		1	2	3	4
1	Formatted text				
2	Originality				
3	Writing ideas				
4	Sources				
5	Alternative solution				
Presentation Grade					

The following rubric is used for assessing student assignment 2.

No	Aspects of Assessment	Scoring Scale			
		1	2	3	4
1	Poster design				
2	Placement of photos or pictures				
3	Poster content				
4	Relevance				
5	Importance				
Presentation Grade					

The following rubric is used for assessing student assignment 3.

Course : Name of Student :
Course Unit : Study Group :

No	Aspects of Assessment	Scoring Scale			
		1	2	3	4
1	Attitude				
2	Continuity				

3	Content				
4	Time Management				
5	Responsive Talk				
Presentation Grade					

Scoring Scale:

1 = inadequate
2 = adequate
3 = good
4 = very good

Presentation Grade = Total score obtained for each student × 5

B.2 ASSESSMENT SYSTEM

Final grade for each student is obtained from each component of assessment below,
Assignments 1 and 2 : 30%
Mid Exam : 30%
Final Exam (Assignment 3) : 40%

B.3 WEIGHT DISTRIBUTION OF ASSESSMENT

Component	CLO-1	CLO-2	CLO-3	CLO-4	TOTAL
Assignments 1 and 2	25	25	25	25	100
Mid Exam	50	50	-	-	100
Final Exam	25	25	25	25	100

Notice that all numerical data in the above table are given in per cent.

B.4 STUDENT GRADE SYSTEM

Final grade for each student is classified below according to a total score obtained,
Excellent : if a total score is greater than or equal to 80
Good : if a total score is greater than or equal to 70
Satisfactory : if a total score is greater than or equal to 55
Failed : if a total score is less than 55

Grade	Interval
A	$85 \leq A < 100$
A-	$80 \leq A- < 85$
B+	$75 \leq B+ < 80$
B	$70 \leq B < 75$
B-	$65 \leq B- < 70$
C+	$60 \leq C+ < 65$
C	$55 \leq C < 60$
D	$40 \leq D < 55$
E	$0 \leq E < 40$

C. COURSE DEVELOPMENT

C.1 A BRIEF REPORT FOR CLASS RESULTS

The following table reports student academic achievement during the course.

Parameter	N	N in per cent
The number of students taking the subject	36	100
The number of students who has passed the course during a normal time	36	100
The number of students who has passed the course by a remedial treatment	-	-
The number of students who has failed the course after taking a remedial treatment	-	-

C.2 ANALYSIS OF CLASS PROBLEMS

Class achievement is recorded very successful with all the student scored greater than 80, classified as excellent. The final scores were only distributed to grades A and A- (both are classified as excellent academic achievement).

C.3 STRATEGY FOR ALTERNATIF SOLUTIONS

N/A. All the students have passed the course with excellent grades.

D. APPENDICES

D.1 DOCUMENTS OF CLASS ACTIVITIES

D.1.1 Weekly Journal

KEMENTERIAN RISET, TEKNOLOGI, DAN PENDIDIKAN TINGGI
UNIVERSITAS NEGERI SURABAYA

Kampus Ketintang
Jalan Ketintang, Surabaya 60231
T: +6231-8293484
F: +6231-8293484
laman: unesa.ac.id
email : bakpk@unesa.ac.id

Aktivitas Perkuliahan

Nama Matakuliah : Fisika Inti **Dosen** : TJIPTO PRASTOWO (196702031995021001)
Kelas : 2017D
Jadwal & Ruang : C03.03.02 (14.40 - 17.10) R.

No.	Tanggal	Pertemuan	Topik	Peserta	Status	Dosen
1	18-09-2020	Pertemuan ke 1	1. Penjelasan RPS Fisika Inti 2. Penjelasan sistem evaluasi dan asesmen Fisika Inti 3. Overview on Nuclear Physics 4. Terminologies on Nuclides 5. Hypothetical electron	36	Terjadwal	Tjipto Prastowo
2	25-09-2020	Pertemuan ke 2	1. Sifat-sifat inti 2. Jejari inti, densitas inti 3. Massa inti 4. Inti stabil dan Inti tak stabil 5. Pita kestabilan inti 6. Energi ikat inti	36	Terjadwal	Tjipto Prastowo
3	02-10-2020	Pertemuan ke 3	1. Sifat-sifat inti 2. Jejari inti, densitas inti 3. Massa inti 4. Inti stabil dan Inti tak stabil 5. Pita kestabilan inti 6. Energi ikat inti 7. Energi pelepasan nukleon 8. Spektroskopi massa isotop	36	Terjadwal	Tjipto Prastowo
4	09-10-2020	Pertemuan ke 4	1. Perbandingan antara hidrogen dan detron 2. Perbandingan antara tingkat energi atom dan tingkat energi inti 3. Gaya inti 4. Enegi ikat detron 5. Spin dan paritas detron	36	Terjadwal	Tjipto Prastowo
5	16-10-2020	Pertemuan	1. Spin dan paritas	36	Terjadwal	Tjipto Prastowo

		ke 5	inti 2. Pita kestabilan inti 3. Interaksi antar nukleon 4. Sumur Fermi nukleon 5. Konfigurasi proton-netron penentu kestabilan inti			
6	**23-10-2020**	Pertemuan ke 6	1. Mekanisme peluruhan radioaktif 2. Prinsip kekekalan muatan dan kekekalan nomer massa 3. Peluruhan alfa, beta, gamma 4. Emisi beta positif dan tangkapan elektron 5. Reaksi inti, Q-value 6. Energi kinetik minimum pada reaksi endoterm	36	Terjadwal	Tjipto Prastowo
7	**30-10-2020**	Pertemuan ke 7	1. Building blocks of matter 2. Klasifikasi partikel elementer 3. Kuark dan Lepton 4. Boson, Hadron, Fermion 5. Partikel dan Anti-Partikel 6. Persiapan UTS	36	Terjadwal	Tjipto Prastowo
8	**06-11-2020**	Pertemuan ke 8	UTS	36	Terjadwal	Tjipto Prastowo
9	**13-11-2020**	Pertemuan ke 9	1. Review soal UTS 2. Building blocks of matter 3. Klasifikasi partikel elementer 4. Kuark dan Lepton 5. Boson, Hadron, Fermion 6. Partikel dan Anti-Partikel	36	Terjadwal	Tjipto Prastowo
10	**20-11-2020**	Pertemuan ke 10	1. Building blocks of matter 2. Klasifikasi partikel elementer 3. Kuark dan Lepton 4. Boson, Hadron, Fermion 5. Partikel dan Anti-Partikel	36	Terjadwal	Tjipto Prastowo
11	**27-11-2020**	Pertemuan ke 11	1. Kuark dan Lepton	36	Terjadwal	Tjipto Prastowo

			2. Boson, Hadron, Fermion 3. Partikel dan Anti-Partikel 4. Hukum Kekekalan Fundamental 5. Fisika Meson			
12	**04-12-2020**	Pertemuan ke 12	1. Standard Model 2. Struktur Kuark dan Lepton 3. Bilangan Baryon dan Lepton 4. Conservation Laws	36	Terjadwal	Tjipto Prastowo
13	**11-12-2020**	Pertemuan ke 13	1. Penemuan meson 2. Jenis meson 3. Karakteristik pion 4. Reaksi inti yang melibatkan pion 5. Teknologi dan energi nuklir 6. Pro dan kontra	36	Terjadwal	Tjipto Prastowo
14	**18-12-2020**	Pertemuan ke 14	1. Belajar mandiri pembuatan poster tematik Fisika Inti (kelompok) 2. Belajar mandiri persiapan presentasi poster Fisika Inti (individual)	36	Terjadwal	Tjipto Prastowo
15	**25-12-2020**	Pertemuan ke 15	Hari Libur Natal 2020	36	Terjadwal	Tjipto Prastowo

D.1.2 Student Attendance

KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
UNIVERSITAS NEGERI SURABAYA

Jl. Lidah Wetan, Surabaya - 60213
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Faksimile :+6231-99424932
e-mail :bakpk@unesa.ac.id

PRESENSI KULIAH
Periode 2020/2021 Gasal

Mata Kuliah : **Fisika Inti** **Dosen** : Prof. Tjipto Prastowo, Ph.D.
Kelas : 2017D
Prodi : S1 Fisika

No	NIM	Nama Mahasiswa	Pertemuan Ke															%
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
			18 Sep 20	25 Sep 20	02 Oct 20	09 Oct 20	16 Oct 20	23 Oct 20	30 Oct 20	06 Nov 20	13 Nov 20	20 Nov 20	27 Nov 20	04 Dec 20	11 Dec 20	18 Dec 20	25 Dec 20	
1.	16030224009	AQBEL QASHMAL BILHAQ	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
2.	17030224001	NOVITA DWI RAHAYU	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
3.	17030224002	DHINI FARIDATUL NISA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
4.	17030224003	RETNO FITRI WULANDARI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
5.	17030224004	FAHIRA NADIVA ERNANDI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
6.	17030224005	ANTONY MAHENDRA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
7.	17030224006	TETI APRILIANI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
8.	17030224007	IQOMATUS SA'DIYAH	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
9.	17030224008	KHOLLI VATUL NUR ISTIQOMAH	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
10.	17030224009	WIDYA RAHMAWATI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
11.	17030224010	GANDHIS PUTRI AYUDIA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
12.	17030224011	ANGELA ARIN PRATAMA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
13.	17030224012	HILDA RISANTI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
14.	17030224013	MOCH. ROMADLON ABDULLOH AKBAR	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
15.	17030224014	NUR HIDAYATI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
16.	17030224015	FRISKA DWI KUSUMA WARDANI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
17.	17030224016	SRI MAULIDIYAH MANGKUASIH	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
18.	17030224018	ANDRIAN DWI SAPUTRO	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
19.	17030224019	IANATUL HUSNIA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
20.	17030224020	VIVIA MAULIDA ALFIANTI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
21.	17030224021	NURIL FATHURIN	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
22.	17030224022	FIRDA RULIFIANGGA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
23.	17030224023	LAILATUL IZZA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
24.	17030224024	MOH. AHSANIT TAQWIM	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
25.	17030224025	IVO NURKHOLIFAH	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
26.	17030224026	SITA NURRACHMAN YURIKA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
27.	17030224027	DIPTYA LATIFA ROHADI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
28.	17030224028	BRILLIYAN HADID SETIAWAN PUTRA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
29.	17030224029	ELGA NILAWATI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
30.	17030224030	AFANDY KADAROSMAN	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
31.	17030224031	KHARISMA FITROTUL UMMAH	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
32.	17030224032	ARYOGHI CAHYO NUGROHO	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
33.	17030224033	DEVI SAPUTRI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
34.	17030224035	DAFFA MAHENDRA	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
35.	17030224036	WINEKE ANGESTI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
36.	17030224037	ERLIN ANDAYANI DEWI	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	100 %
Tanda Tangan Dosen / Asisten																		

D.2 DOCUMENTS OF EXAMS

D.2.1 Mid Exam

KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
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FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
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MID-SEMESTER EXAM
SEMESTER ODD YEAR 2020/2021

Course	**: Nuclear Physics**
Lecturer	**: Tjipto Prastowo, Ph.D**
Study Programme / Class	**: S-1 Physics / 2017D**
Date	**: Friday, 6 November 2020**
Duration / Time	**: 100 minutes / 3.00 – 4.40 pm**
Test Format	**: Open-Book**

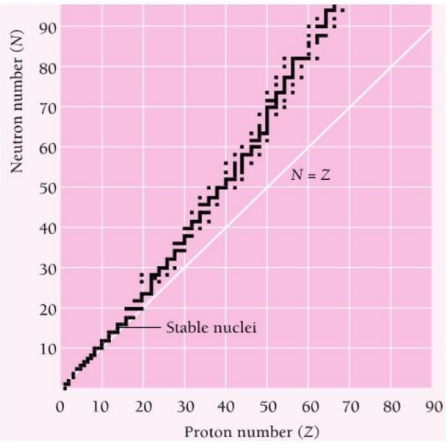
HINTS: Please write carefully your answers to the following questions using all possible sources of study (your notes on weekly discussion on course materials, Lecture Notes on Nuclear Physics, relevant files, internet).

1. 30 point.
   Consider two following radioactive decay processes:

   $Ra^{223} \longrightarrow Pb^{209} + C^{14}$ and $Ra^{223} \longrightarrow Rn^{219} + He^{4}$

   Given that $m(Ra^{223}) = 223.018501$ amu, $m(Pb^{209}) = 208.981065$ amu,
   $m(Rn^{219}) = 229.010082$ amu, $m(C^{14}) = 14.003242$ amu, $m(He^{4}) = 4.002603$ amu,
   then determine Q value for each process and comments on your findings. (CLO 1, 2)

2. 30 point.
   See the stability-band curve for stable nuclei below. Why do stable nuclei having relatively large mass numbers A and atomic numbers Z greater than 20 (nuclides with $Z > 20$) require more neutrons than protons in order to be stable ? (CLO 1, 2)



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3. 40 point.
   Given that masses of neutral atoms of C-14 and N-14 respectively are 14.003242 amu and 14.003074 amu where 1 amu = 1.67×10^{-27} kg, determine the energy release (in MeV) during spontaneous β emission in a decay reaction from an unstable nuclide C-14 to a stable nuclide N-14. (CLO 1, 2).

D.2.2 Final Exam

KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI
UNIVERSITAS NEGERI SURABAYA
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
JURUSAN FISIKA

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FINAL EXAM
SEMESTER 1 ACADEMIC YEAR 2020/2021

COURSE	**: Nuclear Physics**
STUDY PROGRAM / STUDY GROUP	**: Physics / 2017D**
LECTURER	**: Prof. Tjipto Prastowo, Ph.D**
DAY AND DATE	**: Tuesday, 5 January 2021**
DURATION / TIME	**: 100 minutes / 11.00 – 12.40 am**
EXAM TASK	**: Individual Presentation**

HINT: Make a video clip on your individual presentation for final exam on Nuclear Physics Course. You may then better do it with use of any relevant source from weekly course notes, Lecture Notes on Nuclear Physics, and the internet.

NOTES:

1. Send your video clips to tjiptoprastowo@unesa.ac.id or WA: 081231537072
2. Create a short video clip of about 5 minutes long for individual presentation.
3. You may create either separate files of a video clip for each student in the same group or a combined file for a group of students with the same topic of presentation.
4. Focus your presentation on key points of a theme poster created by the group.
5. Evaluation and assessment of your presentation is justified using the following table:

ASSESSMENT OF INDIVIDUAL PRESENTATION

Course : Name of Student :
Course Unit : Study Group :

No	Aspects of Assessment	Scoring Scale			
		1	2	3	4
1	Attitude				
2	Continuity				
3	Content				
4	Time Management				
5	Responsive Talk				
Presentation Grade					

Scoring Scale:
1 = inadequate
2 = adequate
3 = good
4 = very good

Presentation Grade = Total score obtained for each student × 5

D.3 SAMPLES OF STUDENT PERFORMANCE

D.3.1 Short Article (Assignment 1)

Kelompok 1 :
Hilda Risanti (17030224012)
Moh Ahsanit Taqwim (17030224024)
Brilliyan Hadid Setiawan Putra (17030224028)
Daffa Mahendra (17030224035)

90

***Positron Emision Tomography* (PET) Scan**

Positron Emision Tomography (PET) Scan adalah prosedur pengambilan citra fisiologi tubuh yang menggunakan radioisotop pemancar positron dengan hasil yang menggambarkan kelainan fungsi atau metabolisme tubuh. Berbagai kelainan metabolisme di dalam tubuh, termasuk di dalamnya adalah adanya metabolisme sel kanker, gangguan jantung, dan otak, dapat dideteksi melalui PET Scan. Misalnya pada sel kanker, sel kanker mengonsumsi glukosa dalam jumlah yang lebih besar dari pada sel di sekelilingnya. Secara umum, tingkat konsumsi glukosa sel kanker sebanding dengan kecepatan pertumbuhan sel kanker yang mencerminkan tingkat keganasannya. Bentuk metabolisme glukosa di dalam tubuh ini dapat dideteksi menggunakan bahan radiofarmaka.

Perangkat PET secara garis besar dibagi menjadi tiga bagian, yaitu bagian produksi radioisotop, bagian sintesa bahan radiofarmaka, dan bagian kamera PET. Penggunaan PET Scan diawali dengan proses produksi radioisotop fluor-18 (^{18}F). Partikel bermuatan berupa proton ditembakkan dari *cyclotron* ke dalam inti oksigen-18 (^{18}O) dan terbentuklah fluor-18 sambil melepaskan sebuah neutron.

$$^{18}_{8}O + ^{1}_{1}p \rightarrow ^{18}_{9}F + ^{1}_{0}n$$

Radioisotop fluor-18 yang telah didapatkan digunakan untuk mensintesa FDG (2-fluoro-2-deoxy-D-glucose) sehingga terbentuk ^{18}F-FDG. FDG dipilih karena FDG memiliki unsur yang menyerupai glukosa sehingga dapat digunakan untuk melacak sel kanker. Cairan FDG tidak bisa bekerja sendiri. Oleh karena itu, disintesa dengan fluor-18 sehingga dapat bekerja optimal.

Setelah ^{18}F-FDG selesai disiapkan, radiofarmaka tersebut disuntikkan ke tubuh dan kemudian tubuh pasien dimasukkan ke dalam rangkaian detektor elektronik. Radiofarmaka tersebut akan diserap oleh sel kanker. Setelah itu, fluor-18 yang terdapat pada ^{18}F-FDG akan mengalami peluruhan dengan memancarkan positron. Selanjutnya, positron tersebut bertabrakan dengan elektron dalam jaringan tubuh dan terjadilah anihilasi. Anihilasi adalah proses yang terjadi ketika partikel subatomik bertabrakan dengan antipartikelnya untuk menghasilkan partikel lain. Dari anihilasi ini dihasilkan sepasang foton sinar gamma yang terdeteksi oleh detektor sinar gamma. Adanya dua buah foton yang dilepaskan secara bersamaan ini memungkinkan dilakukannya *coincidence detection*.

Pada *coincidence detection,* sinyal yang ditangkap oleh detektor akan diolah jika dua buah sinyal diperoleh secara bersamaan. Jika hanya satu buah sinyal yang ditangkap, maka sinyal tersebut dianggap sebagai pengotor. Seluruh sinyal pengotor akan dieliminasi. Sinyal-sinyal yang ditangkap oleh detektor akan masuk ke bagian *processing unit* untuk dikirim ke *image processing*. Kemudian dilakukan *image reconstruction* untuk mendapatkan gambaran sebaran ^{18}F-FDG di dalam tubuh. Perangkat kamera PET biasanya telah dilengkapi dengan program untuk keperluan ini sehingga hasil *image reconstruction* dapat diperoleh dengan mudah. Kamera PET memiliki kejernihan citra yang lebih baik dibandingkan dengan kamera gamma yang secara umum digunakan pada kedokteran nuklir. Hal ini dikarenakan pendeteksiannya didasarkan pada *coincidence detection*. Dari hasil ini, akan terlihat tingginya konsentrasi FDG pada bagian tertentu yang menunjukkan keberadaan sel kanker. FDG yang tersisa di dalam tubuh pasien akan keluar dari tubuh melalui urin.

Kelebihan ~~dari~~ PET Scan ini adalah ~~PET Scan~~ dapat mendeteksi kelainan fungsi atau metabolisme tubuh pada tingkat sel. Kemampuan PET Scan dalam mendeteksi akan semakin akurat jika digabungkan dengan *Computed Tomography* (CT) Scan karena citra yang dihasilkan tidak hanya menggambarkan fisiologi tubuh, tetapi juga anatomi tubuh sehingga detail yang dihasilkan lebih tinggi. PET Scan juga memiliki kekurangan, diantaranya adalah kemungkinan terjadinya reaksi alergi radiofarmaka, menghasilkan *low radiation exposure* yang masih belum diketahui efek jangka panjangnya, dan dapat menghambat perkembangan janin pada ibu hamil. Can you make your article shorter ?

The following rubric is used for assessing student assignment 1.

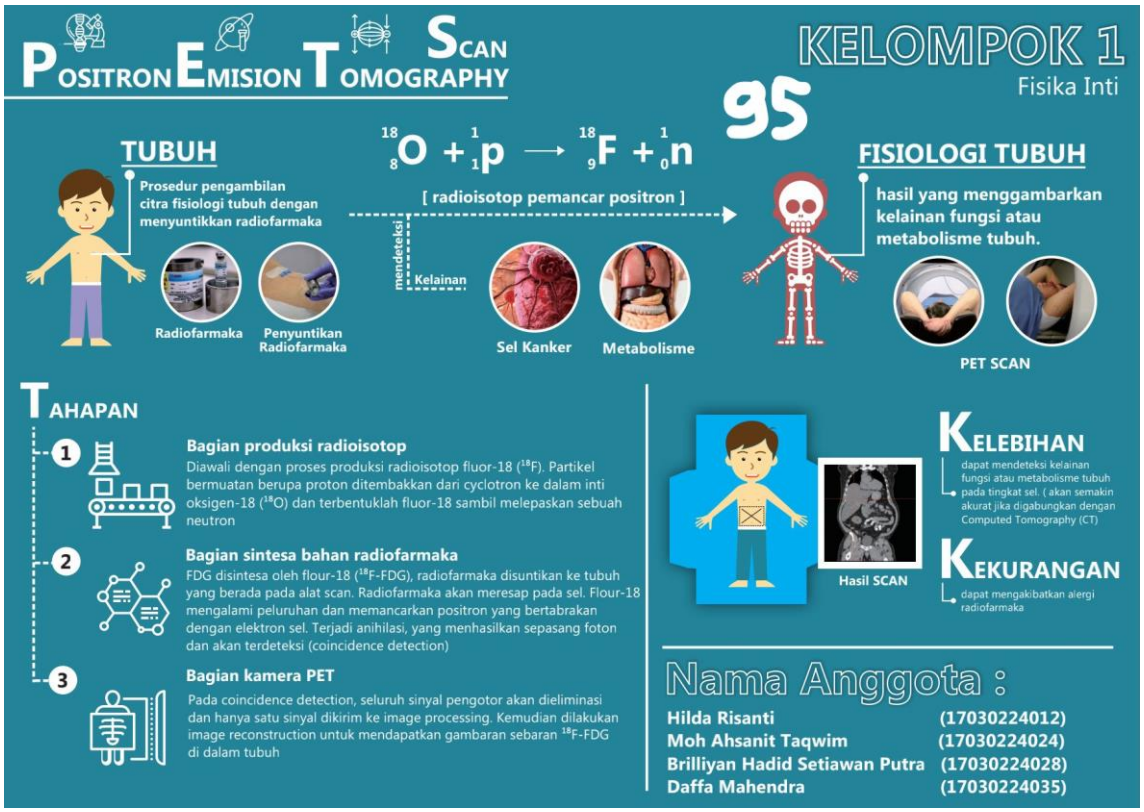
No	Aspects of Assessment	Scoring Scale			
		1	2	3	4
1	Formatted text			✓	
2	Originality				✓
3	Writing ideas				✓
4	Sources				✓
5	Alternative solution			✓	
Presentation Grade		**90**			

Scoring Scale:

1 = inadequate
2 = adequate
3 = good
4 = very good

Presentation Grade = Total score obtained for each student × 5

D.3.2 Thematic Poster (Assignment 2)



The following rubric is used for assessing student assignment 2.

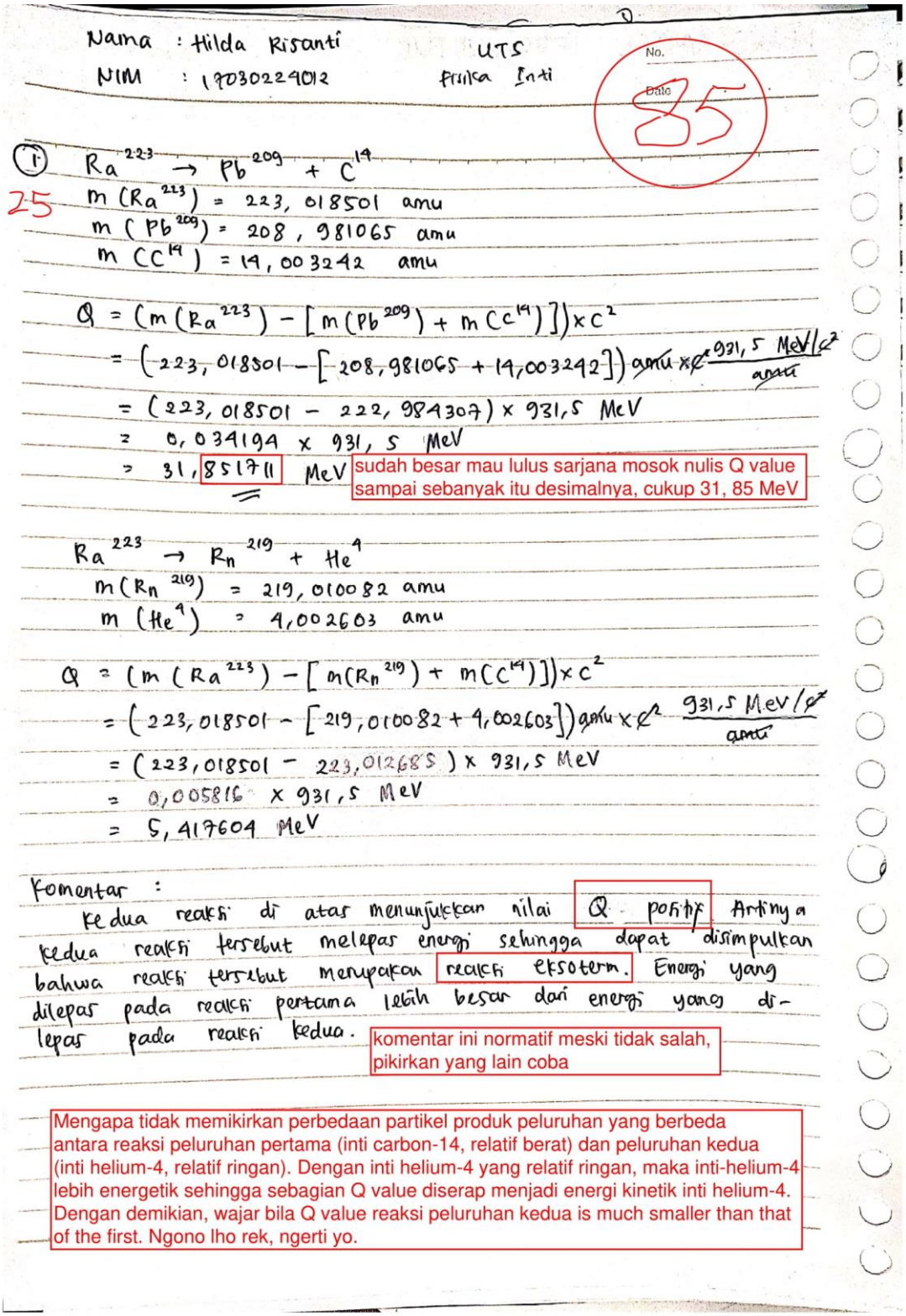
No	Aspects of Assessment	Scoring Scale			
		1	2	3	4
1	Poster design				✓
2	Placement of photos or pictures				✓
3	Poster content				✓
4	Relevance				✓
5	Importance			✓	
Presentation Grade		**95**			

Scoring Scale:

1 = inadequate
2 = adequate
3 = good
4 = very good

Presentation Grade = Total score obtained for each student × 5

D.3.3 Student Work on Mid Exam



Nama : Hilda Risanti
NIM : 1703022 9012

UTS
Fisika Inti

No.
Date
85

25

① $Ra^{223} \rightarrow Pb^{209} + C^{14}$

$m(Ra^{223}) = 223,018501$ amu
$m(Pb^{209}) = 208,981065$ amu
$m(C^{14}) = 14,003242$ amu

$Q = (m(Ra^{223}) - [m(Pb^{209}) + m(C^{14})]) \times c^2$
$= (223,018501 - [208,981065 + 14,003242])$ amu $\times c^2 \frac{931,5 \text{ MeV}/c^2}{\text{amu}}$
$= (223,018501 - 222,984307) \times 931,5$ MeV
$= 0,034194 \times 931,5$ MeV
$= 31,851711$ MeV

sudah besar mau lulus sarjana mosok nulis Q value sampai sebanyak itu desimalnya, cukup 31, 85 MeV

$Ra^{223} \rightarrow Rn^{219} + He^{4}$

$m(Rn^{219}) = 219,0100 82$ amu
$m(He^{4}) = 4,002603$ amu

$Q = (m(Ra^{223}) - [m(Rn^{219}) + m(C^{14})]) \times c^2$
$= (223,018501 - [219,010082 + 4,002603])$ amu $\times c^2 \frac{931,5 \text{ MeV}/c^2}{\text{amu}}$
$= (223,018501 - 223,012685) \times 931,5$ MeV
$= 0,005816 \times 931,5$ MeV
$= 5,417604$ MeV

Komentar :
Kedua reaksi di atas menunjukkan nilai Q positif. Artinya kedua reaksi tersebut melepas energi sehingga dapat disimpulkan bahwa reaksi tersebut merupakan reaksi eksoterm. Energi yang dilepas pada reaksi pertama lebih besar dari energi yang dilepas pada reaksi kedua.

komentar ini normatif meski tidak salah, pikirkan yang lain coba

Mengapa tidak memikirkan perbedaan partikel produk peluruhan yang berbeda antara reaksi peluruhan pertama (inti carbon-14, relatif berat) dan peluruhan kedua (inti helium-4, relatif ringan). Dengan inti helium-4 yang relatif ringan, maka inti-helium-4 lebih energetik sehingga sebagian Q value diserap menjadi energi kinetik inti helium-4. Dengan demikian, wajar bila Q value reaksi peluruhan kedua is much smaller than that of the first. Ngono lho rek, ngerti yo.

Scanned by CamScanner

No.

Date

(2.) Kestabilan suatu inti atom ditentukan oleh perbandingan jumlah neutron (N) dan jumlah proton (Z)

30

* Untuk inti ringan ($Z \leq 20$) stabil jika $N = Z$ atau $N/Z = 1$
* Untuk inti berat ($Z > 20$) stabil jika $N > Z$ atau $N/Z = 1,6$

Inti berat yang stabil membutuhkan jumlah neutron lebih banyak relatif dibandingkan dengan jumlah proton karena dibutuhkan lebih banyak neutron untuk mengatasi interaksi coulomb antar proton berupa gaya tolak menolak agar proton - proton tersebut tidak keluar dari inti sehingga inti tersebut akan tetap stabil.

Dari grafik pita kestabilan inti terlihat bahwa inti - inti stabil membentuk kurva kestabilan ($N = Z$). Inti - inti yang tidak stabil akan melakukan peluruhan untuk menuju kestabilan inti.

(3.) $m(C^{14}) = 14,003242$ sma
$m(N^{14}) = 14,003074$ sma

← massa atom
diketahui dalam soal

30

$$C_6^{14} \rightarrow N_7^{14} + \beta^-$$

$Q = (m(C^{14}) - m(N^{14})) \times c^2$

penerapan rumus ini pada tahap awal dengan menggunakan data massa inti

$= (14,003242 - 14,003074)$ sma $\times c^2$ $\quad \frac{931,5 \text{ MeV}/c^2}{\text{sma}}$

$= 0,000168 \times 931,5$ MeV

$= 0,156492$ MeV

massa x c²

(jumlah massa sebelah kiri - jumlah massa sebelah kanan) x faktor konversi

massa beta negatif harus muncul secara eksplisit pada perurumusan Q value

D.3.4 Student Work on Final Exam

In this stage, students were required to create a video clip containing a short talk on the basis of their own thematic poster for Individual Presentation (Assignment 3). The following picture was taken from a clip made by one of the students, explaining about PET Scan.

The following rubric is used for assessing student assignment 3.

Course : Name of Student :
Course Unit : Study Group :

No	Aspects of Assessment	Scoring Scale			
		1	2	3	4
1	Attitude				✓
2	Continuity				✓
3	Content				✓
4	Time Management			✓	
5	Responsive Talk			✓	
Presentation Grade		**90**			

Scoring Scale:

1 = inadequate
2 = adequate
3 = good
4 = very good

Presentation Grade = Total score obtained for each student × 5

D.4 VALIDATION TEST

D.4.1 Validation Test of Mid Exam

KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
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VALIDATION FORM FOR MID-SEMESTER EXAM

COURSE	:	Nuclear Physics
CLO	:	1. Demonstrating independent and honest characters in doing Mid-Exam on Nuclear Physics. 2. Understanding the basic concepts of nucleus in various perspectives from the discovery of elementary particles constituting nucleus, properties of nuclei, radioactive decays of unstable nuclei to applications of nuclear technology in human lives and its corresponding nuclear waste management.
Lecturer	:	Tjipto Prastowo, Ph.D
Instruction	:	Choose and tick (✓) the appropriate mark in this column for: 1. Adequate 2. Good 3. Excellent

No	Aspects	Category		
		1	2	3
1	Instruction for solving the problems			✓
2	Suitability of each question with CLO	✓		
3	Level balance of easy, medium and difficult questions		✓	
4	Scoring guidelines follow the points of the mark		✓	
5	The duration of completing the questions follows the time available		✓	
6	Allows multiple alternative correct answers	No		
7	Each question does not depend on other questions	Yes		
8	The questions are communicative and do not have ambiguity		✓	
9	Tables, pictures, graphics, maps, or the like are presented clearly and legibly (if any)		✓	

Comments/Suggestions:
Mid-exam questions are in line with CLO for Nuclear Physics Course listed.

Surabaya, 29 October 2020
Validator,

Lydia Rohmawati, S.Si., M.Si
NIP 198405112009122003

Responses from Lecturer:

Surabaya, 30 October 2020
Lecturer,

Tjipto Prastowo, Ph.D
NIP 196702031995021001

D.4.2 Validation Test of Final Exam

KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI
UNIVERSITAS NEGERI SURABAYA
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM

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VALIDATION SHEET FOR FINAL EXAM

Name of Course	:	Nuclear Physics
CLO: 1. Demonstrating independent, creative and honest characters in doing student assignments, mid and final exams. 2. Understanding structured concepts of the nucleus of an atom in many aspects from the history of nuclear discovery to possible applications of nuclear technology and energy, and its corresponding nuclear waste management. 3. Understanding different perspectives of a nuclear power plant and the search for alternative energy based on nuclear reaction. 4. Understanding poster creation with relevant themes of radioisotope decay for various applications in human life.	:	Sub-CLO: 1. Being able to understand the history of nuclear discovery in the context of modern physics, classification of a nuclide based on a specific number of protons and neutrons, and the dominant interaction within the nucleus. 2. Being able to understand nuclear properties in general, the nature of nucleus based on its proton-neutron configuration that leads to stable and unstable nuclei, nuclear characteristics based on binding energy per nucleon, and concepts and measurement techniques of isotope determination. 3. Being able to understand differences between hydrogen and deutron, energy levels of nucleus, nuclear interaction involved, and nuclear characteristics based on its corresponding spin and parity. 4. Being able to understand nuclear models and the roles of nuclear valence in controlling nuclear properties. 5. Being able to understand concepts of stable nuclei and radioactive nuclei, mechanisms of radioactive decay and its corresponding fundamental principles of electric charge and mass-energy conservation. 6. Being able to understand concepts of elementary particles, classification of elementary particles, 'everything is made in pairs', and fundamental conservation laws. 7. Being able to understand the discovery of meson as a carrier between nucleons, types of meson, and nuclear reaction that involves meson, meson resonance. 8. Being able to understand differences between nuclear fission and fusion, potential sources of alternative green energy based on hydrogen fusion, radioactive decay for various applications in human life, nuclear technology, and a nuclear power plant and its corresponding nuclear waste management. 9. Being able to understand some issues associated with nuclear technology and its potential use for various benefits to human life

		through poster creation by a group of students and individual poster presentation.
Lecturer	:	Prof. Tjipto Prastowo, Ph.D
Instruction	:	Give (√) on the column selected: 1. Adequate 2. Good 3. Very Good

No	Aspects	Category		
		1	2	3
1	Instruction for solving the problems			✓
2	Suitability of each question with CLO			✓
3	Level balance of easy, medium and difficult questions		✓	
4	Scoring guidelines follow the points of the mark			✓
5	The duration of completing the questions follows the time available		✓	
6	Allows multiple alternative correct answers			
7	Each question does not depend on other questions			
8	The questions are communicative and do not have ambiguity			✓
9	Tables, pictures, graphics, maps, or the like are presented clearly and legibly (if any)			✓

Comments/Suggestions:
Individual presentation are recorded as clips for alternative Final Exam on Nuclear Physics Course. This is agreement between lecturer and students, which is in line with Semester Lesson Plan (SLP) on Nuclear Physics.

Surabaya, 7 January 2021
Validator,

Mita Anggaryani, Ph.D
NIP 198202022006042002

Response from Lecturer:

Surabaya, 6 January 2021
Lecturer,

Prof. Tjipto Prastowo, Ph.D
NIP 196702031995021001

D.5 CLASS ACADEMIC ACHIEVEMENT

PROGRAM STUDI S1 Fisika
DAFTAR NILAI MAHASISWA
Mata Kuliah : Fisika Inti
Kelas : 2017D
Tahun Ajaran : 2020/2021 Gasal

Original data :

Keterangan :
1. Komponen nilai yang diisi hanya : Part,Tugas,UTS dan UAS
2. Nilai UAS mahasiswa dengan kehadiran dibawah 73.3% (kolom dg warna merah) tidak akan disimpan
3. Jangan merubah apapun di dokumen ini kecuali pada point nomer satu di atas.
4. PPTI / BAAK tidak menerima file nilai untuk diupload. Proses upload nilai dilakukan oleh dosen pengampu yang bersangkutan.

No	NIM	Nama Mahasiswa	Angkatan	Kehadiran	Part	Tugas	UTS	UAS	NA	Huruf	Pakai
1	16030224009	AQBEL QASHMAL BILHAQ	2016	100%	90	85	70	80	81,5	A-	1
2	17030224001	NOVITA DWI RAHAYU	2017	100%	90	77,5	80	80	81,25	A-	1
3	17030224002	DHINI FARIDATUL NISA	2017	100%	90	85	75	80	82,5	A-	1
4	17030224003	RETNO FITRI WULANDARI	2017	100%	90	80	85	85	84,5	A-	1
5	17030224004	FAHIRA NADIVA ERNANDI	2017	100%	90	75	75	90	82,5	A-	1
6	17030224005	ANTONY MAHENDRA	2017	100%	90	82,5	88	85	85,85	A	1
7	17030224006	TETI APRILIANI	2017	100%	90	75	85	80	81,5	A-	1
8	17030224007	IQOMATUS SA'DIYAH	2017	100%	90	75	85	80	81,5	A-	1
9	17030224008	KHOLLI VATUL NUR ISTIQOMAH	2017	100%	90	82,5	80	80	82,75	A-	1
10	17030224009	WIDYA RAHMAWATI	2017	100%	90	75	80	80	80,5	A-	1
11	17030224010	GANDHIS PUTRI AYUDIA	2017	100%	90	85	75	90	85,5	A	1
12	17030224011	ANGELA ARIN PRATAMA	2017	100%	90	80	80	80	82	A-	1
13	17030224012	HILDA RISANTI	2017	100%	90	92,5	85	90	89,75	A	1
14	17030224013	MOCH. ROMADLON ABDULLOH AKBAR	2017	100%	90	85	75	80	82,5	A-	1
15	17030224014	NUR HIDAYATI	2017	100%	90	85	80	85	85	A	1
16	17030224015	FRISKA DWI KUSUMA WARDANI	2017	100%	90	80	85	90	86	A	1
17	17030224016	SRI MAULIDIYAH MANGKUASIH	2017	100%	90	80	80	80	82	A-	1
18	17030224018	ANDRIAN DWI SAPUTRO	2017	100%	90	75	80	85	82	A-	1
19	17030224019	IANATUL HUSNIA	2017	100%	90	82,5	80	85	84,25	A-	1
20	17030224020	VIVIA MAULIDA ALFIANTI	2017	100%	90	77,5	85	80	82,25	A-	1
21	17030224021	NURIL FATHURIN	2017	100%	90	80	80	85	83,5	A-	1
22	17030224022	FIRDA RULIFIANGGA	2017	100%	90	80	80	85	83,5	A-	1
23	17030224023	LAILATUL IZZA	2017	100%	90	85	75	80	82,5	A-	1
24	17030224024	MOH. AHSANIT TAQWIM	2017	100%	90	92,5	80	80	85,75	A	1
25	17030224025	IVO NUR KHOLIFAH	2017	100%	90	85	75	85	84	A-	1
26	17030224026	SITA NURRACHMAN YURIKA	2017	100%	90	85	65	80	80,5	A-	1
27	17030224027	DIPTYA LATIFA ROHADI	2017	100%	90	77,5	75	80	80,25	A-	1
28	17030224028	BRILLIYAN HADID SETIAWAN PUTRA	2017	100%	90	92,5	75	85	86,25	A	1
29	17030224029	ELGA NILAWATI	2017	100%	90	82,5	85	80	83,75	A-	1
30	17030224030	AFANDY KADAROSMAN	2017	100%	90	75	80	80	80,5	A-	1
31	17030224031	KHARISMA FITROTUL UMMAH	2017	100%	90	80	80	80	82	A-	1
32	17030224032	ARYOGHI CAHYO NUGROHO	2017	100%	90	75	80	82	81,1	A-	1
33	17030224033	DEVI SAPUTRI	2017	100%	90	75	75	82	80,1	A-	1
34	17030224035	DAFFA MAHENDRA	2017	100%	90	92,5	75	90	87,75	A	1
35	17030224036	WINEKE ANGESTI	2017	100%	90	77,5	80	80	81,25	A-	1
36	17030224037	ERLIN ANDAYANI DEWI	2017	100%	90	80	85	90	86	A	1