MODULE HANDBOOK

Department of Physics

2022-2026

Faculty of Science and Technology
Universitas Islam Negeri Maulana Malik Ibrahim Malang

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CHAPTER 1
INTRODUCTION

1.1. Background

The development of a Physics Study Program Curriculum Book, grounded in the principles of Outcome-Based Education (OBE), represents a significant advancement in our educational endeavors within the Physics Study Program at the Faculty of Science and Technology, UIN Maulana Malik Ibrahim Malang. The determination to implement an Outcomes-Based Education (OBE) framework in the formulation of our Physics curriculum was predicated upon several compelling factors, specifically:

Modern Era Demands: The modern era demands that graduates have concrete skills and abilities. Education must be pertinent to the demands of the real world, encompassing both the industrial sector and the realm of scientific inquiry. The Outcomes-Based Education (OBE) approach provides a well-defined framework for the identification and attainment of high-quality learning outcomes

Modern Era Demands: The modern era demands that graduates have concrete skills and abilities. Education must be relevant to real world needs, including the world of industry and scientific research. The OBE approach offers a clear framework for identifying and achieving quality learning outcomes.

Response to Scientific Change: Physical science continues to develop rapidly. By adopting an OBE approach, we can more quickly adapt our curriculum to the latest developments in Physics, ensuring that our students are equipped with the most up-to-date and relevant knowledge.

Focus on Holistic Skills and Understanding: The OBE approach allows us to place greater emphasis on developing holistic skills and understanding rather than simply pursuing academic achievement. We want our graduates to not only be good at theoretical physics, but also be able to think critically, communicate effectively, and adapt to complex work environments.

Improved Quality of Learning: By focusing the curriculum on measurable learning outcomes, we can better evaluate the effectiveness of the learning process. This helps us to continuously improve the quality of education we offer to students.

Accreditation Requirements: In line with higher education accreditation requirements, the OBE approach provides an appropriate structure to meet the requirements set by educational regulatory agencies. This supports our efforts to maintain and improve the accreditation of the Physics Study Program.

By considering these factors, we believe that adopting an OBE-based Curriculum approach is the right step in facing the challenges and opportunities in the world of education and modern Physics. This book is an important tool in guiding the implementation of this curriculum, and we hope that it will make a positive contribution to the development of physics and the preparation of our students for a successful future.

1.2. Foundations of Curriculum Design and Development

Philosophical basis, sociological basis, psychological basis, juridical basis, etc.

1.2.1 Philosophical Foundations

Philosophical foundation as a guide at the design, implementation and quality improvement stages of Physics education, how knowledge is assessed and learned so that students in the Physics Study Program understand the nature of life and have the ability to improve the quality of their lives both individually and in the community.

1.2.2 Sociological Foundations

It is the basis for curriculum development as a Physics education tool consisting of objectives, materials, learning activities and a positive learning environment for the acquisition of learner experiences that are relevant to the learner's personal and social development (Ornstein & Hunkins, 2014). The Physics Study Program curriculum must be able to pass on culture from one generation to the next amidst the influence of globalization which continues to erode the existence of local culture. Physics students need to recognize aspects of local culture to protect themselves from the influence of globalization. Plafreyman (2007) states that cultural issues are a hot topic among the academic community in various countries where universities are expected to be able to combine the interests of advancing learning processes that are oriented towards advances in science and technology with elements of cultural diversity of students which can produce learning outcomes with abilities. understand cultural diversity in society, thereby producing a spirit of tolerance and mutual understanding towards the presence of diversity. Physics Study Program students are expected to be able to have cultural agility as a mega competency that must be possessed by prospective Physical Education education professionals in the 21st century, with mastery of at least three competencies, namely, cultural minimization, namely the ability to control oneself and adapt. with standards, cultural adaptation in working conditions at an international level, as well as cultural integration (Caliguri, 2012).

1.2.3 Psychological Foundations

It is the basis for curriculum development, so that the curriculum is able to continuously encourage physics students' curiosity and can motivate lifelong learning; a curriculum that can facilitate Physics students' learning so that they are able to realize their role and function in their environment; a curriculum that can cause students to think critically, and think at a higher level (higher order thinking); a curriculum that is able to optimize the development of students' potential to become the desired human beings (Zais, 1976, p. 200); a curriculum that is able to facilitate students learning to become complete human beings, namely human beings who are free, responsible, self-confident, moral or have noble character, able to collaborate, be tolerant, and become well-educated human beings who are determined to contribute to achieving the ideals in the preamble to the 1945 Constitution.

1.2.4 Juridical Foundation

The legal basis is the basis or reference for the design, development, implementation and evaluation stages, as well as the quality assurance system for higher education which will guarantee the implementation of the curriculum and the achievement of curriculum objectives. Several legal bases in the preparation and implementation of the Physics study program curriculum are:

1) Law of the Republic of Indonesia Number 14 of 2005 concerning Teachers and Lecturers (State Gazette of the Republic of Indonesia of 2005 Number 157, Supplement to State Gazette of the Republic of Indonesia Number 4586);
2) Law of the Republic of Indonesia Number 12 of 2012 concerning Higher Education (State Gazette of the Republic of Indonesia of 2012 Number 158, Supplement to State Gazette of the Republic of Indonesia Number 5336); c.
3) Presidential Regulation of the Republic of Indonesia Number 8 of 2012, concerning the Indonesian National Qualifications Framework (KKNI);
4) Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 73 of 2013, concerning the Implementation of KKNI in the Higher Education Sector;
5) Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia Number 62 of 2016 concerning the Higher Education Quality Assurance System;
6) Minister of Research, Technology and Higher Education Regulation Number 59 of 2018, concerning Diplomas, Competency Certificates, Professional Certificates, Degrees and Procedures for Writing Degrees in Higher Education;
7) Decree of the Minister of Research, Technology and Higher Education No. 123 of 2019 concerning Internships and Recognition of Industrial Internship Semester Credit Units for Applied Undergraduate and Undergraduate Programs.
8) Minister of Education and Culture Regulation no. 3 of 2020, concerning National Higher Education Standards;
9) Minister of Education and Culture Regulation no. 5 of 2020, concerning Accreditation of Study Programs and Higher Education Institutions
10) Minister of Education and Culture Regulation no. 7 of 2020 concerning the Establishment of Changes, Dissolution of State Universities, and the Establishment, Changes, and Revocation of Private Higher Education Licenses.
11) Minister of Education and Culture Regulation no. 22 of 2020, concerning the Strategic Plan of the Ministry of Education and Culture

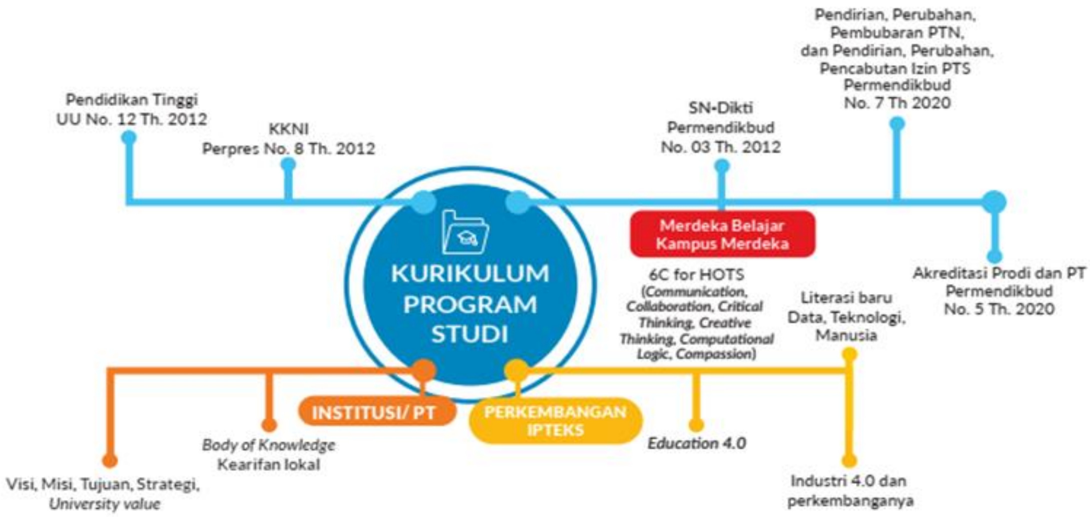

Figure 1. Legal, National Policy and Institutional Foundations
Higher Education Curriculum Development

1.3 Aims and Objectives

Aims and Objectives of Creating a Physics Study Program Curriculum Book based on the Outcome-Based Education (OBE) Curriculum:

1.3.1 Aims

The creation of a Physics Study Program Curriculum Book based on the Outcome-Based Education (OBE) Curriculum has the following aims:

Improving the Quality of Education: One of the main purposes of creating the OBE-based Physics Study Program Curriculum Book is to improve the quality of education in the Physics Study Program. By adopting an OBE approach, we hope to provide a more relevant and measurable education, suited to student needs and the demands of the ever-changing world of work.

Providing Clear Guidance: This book aims to provide clear guidance to lecturers, students and other interested parties about what is expected from the physics study program. This helps in preparing effective learning plans and in evaluating the achievement of learning outcomes.

Integrating Physics Concepts and Skills: The intent is to integrate physics concepts with student skill development. We want our graduates to not only have a solid understanding of physics, but also have the ability to apply that knowledge in real-world situations.

Provides an Evaluation Framework: This book creates a clear framework for evaluating student achievement of learning outcomes. This helps in measuring the extent to which the curriculum has achieved the educational goals that have been set.

1.3.2 Objectives

The creation of a Physics Study Program Curriculum Book based on the Outcome-Based Education (OBE) Curriculum has the following objectives:

Producing Quality Graduates: One of the main objectives of the OBE-based Physics Study Program Curriculum Book is to produce quality graduates. We want our students to have a deep understanding of physics and be able to compete well in the world of work or pursue further studies.

Encourage Skills Development: We strive to encourage the development of skills such as critical thinking, communicating effectively, collaborating, and problem solving. The goal is that our graduates are ready to face various challenges in their careers.

Providing an Effective Evaluation Framework: This book aims to provide an effective evaluation framework, which allows us to systematically measure student achievement of learning outcomes and make continuous improvements in the curriculum.

Adapting to the Latest Developments: We want this curriculum to remain relevant to the latest developments in physics and the scientific world. This enables us to produce graduates who have a cutting-edge understanding of their discipline.

Improving Study Program Accreditation and Reputation: By adopting the OBE approach and providing a comprehensive curriculum book, we hope to improve the accreditation and reputation of our Physics Study Program at national and international levels.

By achieving these aims and objectives, we hope that this OBE-based Physics Study Program Curriculum Book will help create a better educational experience for our students and increase our contribution to the development of physical science.

CHAPTER 2
CURRICULUM OF PHYSICS DEPARTMENT

Study Program	**Physics**
Education Level	**Bachelor Program (S1)**

2.1. Study Program Description

University	:	UIN Maulana Malik Ibrahim Malang
Faculty	:	Science and Technology
Department	:	Physics
Accreditation	:	B
Educational Level	:	Bachelor (Level 6)
Graduate Degree	:	S.Si (Sarjana Sains/Bachelor of Science)
Vision of the Study Program	:	The Physics Department will be an integrative study program in combining science and Islam with an international reputation
Mission		1. To prepare a Bachelor of Physics with Ulul Albab character (The character of Ulul Albab refers to aspects of spiritual depth and moral greatness, language and religious moderation). 2. To conduct a relevant and highly competitive science, technology, art in Physics.

2.2. Study Program Scientific Vision

To develop physics that combines science and Islam through learning and research in the field of renewable energy, advanced materials, environment, health, and food security to create Bachelor of Physics with Ulul Albab character.

Various efforts have been made to promote the development of physics, apart from fulfilling the technology needed, the demand for materials and energy to sustain life is increasing. We are also aimed at catching up with Indonesia's physical limitations compared to other countries, especially countries in Asia, and the world in general. Through the development of research, especially research in the field of accelerated pure physics, we hoped that this backwardness can be overcome. This is the main task for tertiary institutions and faculties, or study programs engaged in pure scientific development, in this case, the Faculty of Science and Technology.

The Physics Study Program as part of Physics and Natural Sciences was developed based on the premise that the Qur'an is the source of all sources of knowledge, especially physics. Based on this, the search for truth in physics is not only limited to scientific truth but also through exploring the truth through more complete or comprehensive sources. In this case, science and religion are seen and functioned in an integrated manner, apart from exploring the truth together, each is complementary. The Al-Qur'an will be understood more broadly if it includes physics, and vice versa physics will develop if it gets inspiration from the recitation of the Al-Qur'an. Even by studying physics, a true and comprehensive understanding of Islam will be obtained.

2.3. Program Education Objective

PEO	Description
PEO-1	Capable of mastering and using physics concepts in the practice of their career
PEO-2	Capable of thinking critically, creatively, and innovatively in the workplace
PEO-3	Responsible in carrying out their responsibilities and adhering to professional ethics based on Islamic beliefs
PEO-4	Have independence and the ability to collaborate to improve and advance Physics and its applications in society as technopreneurs
PEO-5	Develop into a person with the ability to further your education

2.4. Profile Outcome

PO Code	PL Description	Profession
PO-01	Research assistant who is able to design appropriate physics research procedures, analyze data accurately, compile research reports according to scientific standards based on Islamic values.	Research assistant
PO-02	Physics practitioners who can analyze physics concepts to solve industrial and technological problems, as well as create technopreneurs opportunities based on Islamic values.	Physics practitioners
PO-03	Bachelor who develops physics knowledge for educational purposes based on Islamic value	Academics

2.5. Program Learning Outcomes

PLO	Description
PLO-1	Able to adapt academic norms and ethics in the implementation of science and technology in religious social, national, and state life based on Islamic values.
PLO-2	Able to build a responsible attitude, spirit of independence, and entrepreneurship according to their field of expertise.

PLO-3	Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values.
PLO-4	Able to develop networks and work together in teams based on scientific ethics to produce scientific ideas based on science and technology.
PLO-5	Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.
PLO-6	Able to correlate Islamic knowledge, integration of Islam, and science as a scientific paradigm.
PLO-7	Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science.
PLO-8	Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

2.6. Relation between Program Objectives and Learning Outcomes

Relation Matrix		Learning Outcomes							
		PLO-01	PLO-02	PLO-03	PLO-04	PLO-05	PLO-06	PLO-07	PLO-08
Program Objectives	PEO-1			√	√	√		√	√
	PEO-2			√	√				
	PEO-3	√	√				√		
	PEO-4	√	√	√					
	PEO-5			√	√	√		√	√

2.7. Curriculum / Study Plan of Physics Department

Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
Pancasila	Civic Education	English Language I	English Language II	Mathematical Physics III	Student Work Course	Elective Course	Undergraduate Thesis
Indonesian Language	Arabic Language III: Advanced Listening and Speaking	Study of the Qur'an and Al Hadith	Instrumentation and Measurement	Electricity and Magnetism II	Internship		

Arabic Language I: Intermediate Listening and Speaking	Arabic IV	Study of Fiqh	Renewable Energy	Introduction of Nuclear Physics	Statistical Physics		
Arabic Language II: Intermediate Reading and Writing	History of Islamic Civilization	Fluid Physics	Mathematical Physics II	Optics	Introduction of Solid State		
Philosophy of Science	Theosophy	Mathematical Physics I	Electronics II	Quantum Physics	Physics Seminars		
Fundamental of Mathematics I	Fundamental of Mathematics II	Electronics I	Waves	Thermodynamics	Elective Course		
Biology	Fundamental of Physics II	Classical Mechanics	Digital Electronics	Research Methods			
Fundamental of Chemistry	Earth Science	Modern Physics	Electricity and Magnetism I	Entrepreneurship			
Fundamental of Physics I	Statistics	Alternating Current	Signal Processing	Elective Course			
Practical Astronomy	Algorithms and Programming	Experimental Physics	Experimental Physics I				

University Course
PSP Course
Elective Course

2.7.1. Compulsory Courses

No.	Course Code	Name of Course	Credits (SKS/ECTS)
		SEMESTER I	
1	20000011A01	Pancasila	2 / 2.94
2	20000011A03	Indonesian Language	2 / 2.94
3	20000011A04	Arabic Language I: Intermediate Listening and Speaking	2 / 2.94
4	20000011A05	Arabic Language II: Intermediate Reading and Writing	2 / 2.94
5	20000011A010	Philosophy of Science	2 / 2.94
6	22060411C02	Fundamental of Mathematics I	3 / 4.41
7	22060411E01	Biology	2 / 2.94
8	22060411E02	Fundamental of Chemistry	2 / 2.94
9	22060411E04	Fundamental of Physics I	3 / 4.41

10	22060411E08	Astronomy	2 / 2.94
		Total Credits (SKS / ECTS)	22 /32.34
SEMESTER II			
1	20000011A02	Civic Education	2 / 2.94
2	20000011A06	Arabic Language III: Advanced Listening and Speaking	2 / 2.94
3	20000011A07	Arabic IV	2 / 2.94
4	20000011A11	History of Islamic Civilization	2 / 2.94
5	20000011A12	Theosophy	2 / 2.94
6	22060411E03	Fundamental of Mathematics II	3 / 4.41
7	22060411E05	Fundamental of Physics II	3 / 4.41
8	22060411E07	Earth Science	2 / 2.94
9	22060411E09	Statistics	2 / 2.94
10	22060411E12	Algorithms and Programming	2 / 2.94
		Total Credits (SKS / ECTS)	22/32.34
SEMESTER III			
1	20000011A08	English Language I	3 / 4.41
2	20000011A13	Study of Al-Qur'an and Al-Hadith	2 / 2.94
3	20000011A14	Fiqh	2 / 2.94
4	22060411E06	Fluid Physics	2 / 2.94
5	22060411E13	Mathematical Physics I	3 / 4.41
6	22060411E16	Electronics I	2 / 2.94
7	22060411E18	Classical Mechanics	3 / 4.41
8	22060411E19	Modern Physics	3 / 4.41
9	22060411E20	Alternating Current	2 / 2.94
10	22060411D25	Experimental Physics I	2 / 2.94
		Total Credits (SKS/ECTS)	24 / 35.28
SEMESTER IV			
1	20000011A09	English Language II	3 / 4.41
2	22060411E10	Instrumentation and Measurement	2 / 2.94
3	22060411E11	Renewable Energy	2 / 2.94
4	22060411E14	Mathematical Physics II	3 / 4.41
5	22060411E17	Electronics II	2 / 2.94
6	22060411E21	Waves	3 / 4.41
7	22060411E22	Digital Electronics	2 / 2.94
8	22060411E23	Electricity and Magnetism I	2 / 2.94
9	22060411E25	Signal Processing	2 / 2.94
10	22060411E29	Experimental Physics II	2 / 2.94
		Total Credits (SKS/ECTS)	23 / 33.81
SEMESTER V			
1	22060411E15	Mathematical Physics III	3 / 4.41
2	22060411E24	Electricity and Magnetism II	2 / 2.94
3	22060411E26	Introduction to Nuclear Physics	2 / 2.94

4	22060411E27	Optics	2 / 2.94
5	22060411E30	Quantum Physics	3 / 4.41
6	22060411E31	Thermodynamics	3 / 4.41
7	22060411E32	Research Methods	2 / 2.94
8	22060411E36	Entrepreneurship	2 / 2.94
		Elective Courses	4 / 5.88
		Total Credits (SKS/ECTS)	23 / 33.81
		SEMESTER VI	
1	20000011A15	Community Services	2 / 2.94
2	22060411C01	Internship	2 / 2.94
3	22060411E33	Statistical Physics	3 / 4.41
4	22060411E34	Introduction to Solid State Physics	3 / 4.41
5	22060411E35	Physics Seminars	2 / 2.94
		Elective Courses	12 / 17.64
		Total Credits (SKS/ECTS)	24 / 35.28
		SEMESTER VII	
		Elective Courses	4 / 5.88
		Total Credits (SKS/ECTS)	4 / 5.88
		SEMESTER VIII	
1	22060411E37	Undergraduate Thesis	6 / 8.82
		Total Credits (SKS/ECTS)	6 / 8.82

2.7.2. Elective Courses

No.	Course Code	Name of Course	Credits (SKS / ECTS)
		SEMESTER V	
1	22060411F01	Theory of Special Relativity	2 / 2.94
2	22060411F02	Introduction to Astrophysics and Cosmology	2 / 2.94
3	22060411F11	Sensor and Transducer	2 / 2.94
4	22060411F12	Control System	2 / 2.94
5	22060411F21	Seismology	2 / 2.94
6	22060411F22	Petroleum Geology	2 / 2.94
7	22060411F31	Anatomy and Physiology	2 / 2.94
8	22060411F32	Radiation Physics	2 / 2.94
9	22060411F41	Introduction to Material Physics	2 / 2.94
10	22060411F42	Composite Materials	2 / 2.94
		SEMESTER VI	
1	22060411F03	Introduction to Particle Physics	2 / 2.94
2	22060411F04	Group Theory	2 / 2.94
3	22060411F05	Theory of General Relativity	2 / 2.94
4	22060411F06	Quantum Mechanics	2 / 2.94
5	22060411F07	Advanced Computational Physics	2 / 2.94

6	22060411F08	Capita Selecta in Theoretical Physics	2 / 2.94
7	22060411F13	Electric Motor	2 / 2.94
8	22060411F14	Microcontroller	2 / 2.94
9	22060411F15	Analog Electronics	2 / 2.94
10	22060411F16	Interfacing	2 / 2.94
11	22060411F17	Modern Optics	2 / 2.94
12	22060411F19	Artificial Intelligence	2 / 2.94
13	22060411F23	Volcanology and Geothermal	2 / 2.94
14	22060411F24	Seismic Exploration	2 / 2.94
15	22060411F25	Gravity Fields and Geomagnetic Exploration	2 / 2.94
16	22060411F27	Stratigraphy and Geology Structure	2 / 2.94
17	22060411F28	Geoelectric and Electromagnetics Exploration	2 / 2.94
18	22060411F30	Formation Evaluation	2 / 2.94
19	22060411F33	Biomechanics and Bioelectric	2 / 2.94
20	22060411F34	Biomaterials	2 / 2.94
21	22060411F35	Computational Biophysics	2 / 2.94
22	22060411F36	Biosensor	2 / 2.94
23	22060411F37	Laser and Bio-optic	2 / 2.94
24	22060411F38	Medical Instrumentation	2 / 2.94
25	22060411F43	Material Processing	2 / 2.94
26	22060411F44	Material Characterizations	2 / 2.94
27	22060411F45	Advanced Materials	2 / 2.94
28	22060411F46	Electronic Materials	2 / 2.94
29	22060411F49	Capita Selecta in Material Physics	2 / 2.94
30	22060411F50	Computational of Material Physics	2 / 2.94
		SEMESTER VII	
1	22060411F09	Relativistic Quantum Theory	2 / 2.94
2	22060411F10	Quantum Field Theory	2 / 2.94
3	22060411F18	Robotics	2 / 2.94
4	22060411F20	Electronics Workshop	2 / 2.94
5	22060411F26	Meteorology and Climatology	2 / 2.94
6	22060411F29	GIS and Remote Sensing	2 / 2.94
7	22060411F39	Imaging Physics	2 / 2.94
8	22060411F40	Biomagnetics	2 / 2.94
9	22060411F47	Crystal Diffraction	2 / 2.94
10	22060411F48	Materials Experiment	2 / 2.94

2.8. Modul Handbook

PANCASILA (20000011A01)

Module designation	Pancasila
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Atika Candra Larasati
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-01 Students are Able to adapt academic norms and ethics in the implementation of science and technology in religious social, national, and state life based on Islamic values . PLO-02 Students are able to develop a responsible attitude, spirit of independence, and entrepreneurship according to their field of expertise.
CO	CO-011 Able to uphold human values in social, national and state life. CO-021 Able to show a responsible attitude in accordance with Pancasila.

Content	1. The urgency of Pancasila education. Understanding the historical, cultural, juridical and philosophical foundations of Pancasila education. Description, vision, mission and objectives of Pancasila education. 2. Pancasila in the context of the history of the nation's struggle; Understanding the history of the struggle during national glory, Understanding the history of the Dutch colonial period. Understanding the struggle of the Indonesian people 4. History of the formulation of Pancasila; Understanding the Japanese colonial period, BPUPKI Session 1, BPUPKI Session 2, PPKI Session 18 August 1945, Chronology of the history of the formulation of the preamble and articles of the 1945 Constitution, Position and meaning of the preamble to the 1945 Constitution. 5. Pancasila as the basis of the state; the theory of the position of Pancasila as the basis of the state according to Hans Kelsen, the theory of the position of Pancasila as the basis of the state according to Hans Nawiasky, the theory of the position of Pancasila as the basis of the state according to Indonesian legal regulations , Legal hierarchy in Indonesia, Function of Pancasila as the basis of the state, forms of practice of Pancasila as the basis of the state. 6. Pancasila as a philosophical system; understanding of philosophy, systems and branches of philosophy, unity of principles as a systematic, hierarchical and logical unity, elements of Pancasila. Pancasila as a philosophical system. 7. Pancasila as political ethics; Understanding ethics, political ethics and government, Pancasila as political ethics and the values contained therein, applying ethics in professional life, state society and critical evaluation of ethics. 8. Pancasila as State Ideology; understanding, meaning of ideology for the nation and state, various ideologies that exist in the world (Liberalism, Communism, Fascism, Marxism, Pancasila), meaning

	and role of Pancasila ideology as the ideology of the nation and state 9. Pancasila as a paradigm for life in society, nation and state; understanding paradigm, Pancasila as a development paradigm in the fields of politics, economics, social, culture, law, inter-religious life and science and technology. Pancasila as a reform paradigm, Pancasila as a paradigm for campus life. 10. Pancasila in the Constitutional Context of the Republic of Indonesia; understanding the position of Pancasila as a source of law, the content and position of the preamble to the 1945 Constitution, the Indonesian constitutional system before and after the amendment to the 1945 Constitution. 11. Dynamics of implementation of the 1945 Constitution before the reform period; implementation of the 1945 Constitution during the early days of independence, implementation of the 1945 Constitution during the Old Order, implementation of the 1945 Constitution during the New Order. 12. Dynamics of implementation of the 1945 Constitution after the reform period; background to the birth of the reform period, amendments I, II, III and IV of the 1945 Constitution, changes to the constitutional system of the Republic of Indonesia after amendments to the 1945 Constitution. 13. Pancasila and the realization of human rights in Indonesia; Understanding human rights, human rights in the 1945 Constitution, rights and obligations as citizens, realization of human rights in Indonesia 1.4 Pancasila and its relationship with Islamic teachings; The first principle in the view of Islamic teachings, the second principle in the view of Islamic teachings, the third principle in the view of Islamic teachings, the fourth principle in the view of Islamic teachings, the fifth principle in the view of Islamic teachings.
Examination forms	Paper Based Test

Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Tukiran Taniredja, dkk., Paradigma Baru Pendidikan Pancasila untuk Mahasiswa, Penerbit Alfabeta, Bandung, 2015. 2. Abdul Hamid, KH., dkk., Pendidikan Pancasila dan Kewarganegaraan, Penerbit CV. Pustaka Setia, Bandung, 2012. 3. Kansil, C.S.T., Pancasila dan Undang Undang Dasar 1945, PT. Pradnya Paramita, Jakarta, 2002. 4. Kaelan, Pendidikan Pancasila, Paradigma, Yogyakarta, 2000. 5. Problem Epistemologis Empat Pilar Berbangsa dan Bernegara, Yogyakarta, 2012. 6. Bahar, Safroedin, Risalah Sidang Badan Penyelidik Usaha-Usaha Persiapan Kemerdekaan Indonesia (BPUPKI), Panitia Persiapan Kemerdekaan Indonesia (PPKI) 28 Mei 1945-22 Agustus 1945, Sekretariat Negara Republik Indonesia, Jakarta, 1995. 7. Anshari, Endang Saifuddin, 1981, Piagam Jakarta 22 Juni 1945 dan Sejarah Konsensus Nasional antara Nasionalis Islam dan Nasionalis “Sekuler” tentang Dasar Negara Republik Indonesia 1945-1959, Pustaka-Perpustakaan Salman ITB, Bandung. 8. Notosusanto, Nugroho, 1981, Proses Perumusan Pancasila Dasar Negara, PN Balai Pustaka, Jakarta. 9. Sunoto, Mengenal Filsafat Pancasila, PT. Hanindita Graha Widya, Yogyakarta, 1991. 10. Yudi Latif, Negara Paripurna: Historisitas, Rasionalitas dan Aktualitas Pancasila, PT. Gramedia Pustaka Utama, Jakarta, 2011. 11. Ahmad, Amrullah dkk., Dimensi Hukum Islam Dalam Sistem Hukum Nasional, Gema Insani, Depok, 1996. 12. Kementerian Pendidikan dan Kebudayaan, Materi Ajar Mata Kuliah Pendidikan Pancasila, Jakarta, 2013. Additional: 1. Kementrian Riset, Teknologi dan Pendidikan Tinggi Republik Indonesia, Direktorat Jenderal Pembelajaran dan Kemahasiswaan Pendidikan Pancasila Untuk Perguruan Tinggi, Jakarta, 2016.

CIVIC EDUCATION (20000011A02)

Module designation	Civic Education
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Sulis Eka Ariyaning Putri, M.Pd
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: Pancasila (20000011A01)
Module objectives/intended learning outcomes	PLO-2 Students are able to develop a responsible attitude, spirit of independence, and entrepreneurship according to their field of expertise. PLO-3 Students are able to encourage technopreneurship founded on Islamic principles by applying rational, methodical, creative, and autonomous thinking in science and technology
CO	CO-022 Able to show a responsible attitude in accordance with citizenship understanding. CO-023 Able to apply logical thinking in developing citizenship science based on Islamic ethics.

Content	1. The essence of citizenship education in developing complete graduate or professional abilities 2. The essence and urgency of national identity as a determinant of nation and character development 4. The urgency of national integration as one of the parameters of national unity and integrity I 5. The urgency of national integration as one of the parameters of national unity and integrity II 6. Constitutional values and norms of the 1945 Constitution of the Republic of Indonesia and the constitutionality of statutory provisions under the Constitution; 7. Harmony of obligations and rights of the state and citizens in a democracy that is based on popular sovereignty and deliberation to reach consensus 8. The essence, instrumentation and praxis of Indonesian democracy are based on Pancasila and the 1945 Constitution of the Republic of Indonesia I 9. The essence, instrumentation and practice of Indonesian democracy are based on Pancasila and the 1945 Constitution of the Republic of Indonesia II 10. Historical constitutional, socio-political, cultural dynamics, as well as the contemporary context of just law enforcement 11. Historical dynamics and the urgency of insight into the archipelago as a collective conception and view of Indonesian nationality in the context of world relations
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Sinamo, Nommensen.(2010). Pendidikan kewarganegaraan untuk perguruan tinggi. Jakarta: Bumi Intitama Sejahtera. 2. Tobroni Dkk. (2007). Pendidikan Kewarganegaraan: Demokrasi, HAM, Civil Society, dan Multikulturalisme. Malang: PuSPAKom. 3. 3. Bakry, Noor Ms. (2009). Pendidikan Kewarganegaraan. Yogyakarta: Pustaka Pelajar. 4. Aryani, I.K. & Susatim, M. (2010). Pendidikan kewarganegaraan berbasis nilai. Bogor: Ghalia Indonesia 5. Bakry, N. (2010).Pendidikan Kewarganegaraan. Yogyakarta: Pustaka Pelajar 6. Dwiyanti, S.H. (2012). Pendidikan Kewarganegaraan. Yogyakarta: Pustaka Pelajar 7. Erwin, M. (2010). Pendidikan kewarganegaraan Republik Indonesia. Bandung: Refika Aditama 8. Minto, R. (2009). Pendidikan kewarganegaraan: Perjuangan menghidupi jati diri. Jakarta: Grasindo 9. Nommensen Sinamo. (2012). Pendidikan kewarganegaraan untuk perguruan tinggi. Jakarta: Permata Aksara 10. Wahidin. (2010). Pokok-pokok pendidikan kewarganegaraan. Yogyakarta: Pustaka Pelajar 11. Nurdin, E.S. (2015). The policies on civic education in developing national character in Indonesia. International Education Studies; Vol. 8, No. 8; 2015. Aditional: 1. Kementrian Riset, Teknologi dan Pendidikan Tinggi Republik Indonesia, Direktorat Jenderal Pembelajaran dan Kemahasiswaan Pendidikan Pancasila Untuk Perguruan Tinggi, Jakarta, 2016.

INDONESIAN LANGUAGE (20000011A03)

Module designation	Indonesian Language
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Yoga Yolanda, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-03 Students are able to encourage technopreneurship founded on Islamic principles by applying rational, methodical, creative, and autonomous thinking in science and technology. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science
CO	CO-031 Student are able to apply systematic thinking in using Indonesian. CO-032 Student are able to disseminate the results of scientific studies in oral and written communication according to Indonesian language rules.

Content	1. General description and functions of the Indonesian language 2. Linguistic Rules 3. Critically examine various information as a pre-writing activity 4. Code of Ethics for Writing Scientific Work 5. Content and Systematics of the Paper 6. Content and Systematics of Scientific Articles 7. Self-editing techniques and publication of scientific articles
Examination forms	Oral Presentation
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Kamus Besar Bahasa Indonesia. (Daring). kbbi.kemdikbud.go.id. 2. SK Kepala Badan Pengembangan dan Pembinaan Bahasa. Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia Nomor 0424/1/BS/.00.01/2022 tentang Ejaan Bahasa Indonesia yang Disempurnakan. 3. Pedoman Umum Pembentukan Istilah 4. Pujiono, Setyawan. 2013. Terampil Menulis: Cara Mudah dan Praktis dalam Menulis. Yogyakarta: Graha Ilmu. 5. Suyitno, Imam. 2012. Menulis Makalah dan Artikel. Bandung: Refika Aditama. 6. Suyono, Rizka Amaliah, Dewi Ariani, dan Ariva Luciandika. 2016. Cerdas Menulis Karya Ilmiah. Malang: Gunung Samudra. Additional: 1. Furchan, Arief. (2016). Cara Mudah Menulis Makalah. Surabaya: UIN Sunan Ampel Press. 2. Furchan, Arief. (2016). Cara Menulis Paragraf yang Efektif. Surabaya: UIN Sunan Ampel Press. 3. Suyitno, I. (2011). Karya Tulis Ilmiah: Panduan, Teori, Pelatihan, dan Contoh. Bandung: Refika Aditama. 4. Suyitno, I. (2012). Menulis Makalah dan Artikel. Bandung: Refika Aditama. 5. Suyono, Rizka Amaliah, Dewi Ariani, dan Ariva Luciandika. (2016). Cerdas Menulis Karya Ilmiah. Malang: Gunung Samudra. 6. Widyarto, D. (2012). Bahasa Indonesia Riset. Malang: UB Press.

ARABIC LANGUAGE I: INTERMEDIATE LISTENING AND SPEAKING (20000011A04)

Module designation	Arabic Language I: Intermediate Listening and Speaking
Semester(s) in which the module is taught	1^{st} Semester
Person responsible for the module	TIM PKPBA
Language	Indonesian; Bahasa arab
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Group Discussion 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-01 Students are able to adapt academic norms and ethics in the implementation of science and technology in religious social, national, and state life based on Islamic values. PLO-06 Students are able to implement Islamic knowledge, integration of Islam, and science as a scientific paradigm. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO-041 Student are able to apply academic norms and ethics based on the character of ulul albab in Arabic 1. CO-046 Student are able to analyze a scientific paradigm in Arabic 1. CO-048 Student are able to disseminate the results of scientific studies in oral and written communication according to Arabic language rules.
Content	The study material comes from Al-'Arabiyah Lil Hayah (ALH) which includes: Al-Ta'aruf, Al-Usrah, Al-Sakan, Al-Ansyitah Al-Yaumiyah, Al-Dirasah, Al-Hiwayaat, Al-Amal and Ar -rihlah
Examination forms	Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Hamid, Muhammad Abdul dkk. 2018. Al Arabiyah lil Hayah,. Malang: UIN Maliki Press. Buku 1 dan 2 2. Hamid, Muhammad Abdul dkk. 2018. Kamus al-musa’id li Al Arabiyah lil Hayah, Malang: UIN Maliki Press Additional : 1. محمود إسماعيل صيني، وناصف مصطفى عبد العزيز، ومختار الطاهر حسين، العربية للناشئين، المملكة العربية السعودية: إدارة الكتب المدرسية، وزارة المعارف، 1403 هـ. 2. محمد بن عبد الرحمن آل الشيخ (مشرف)، العربية بين يديك، الرياض-المملكة العربية السعودية: العربية للجميع، 1435 هـ. 3. محمد عبد الحميد، ومحمد عبد الله حارس، ودانيال حلمي، معجم العربية للحياة، مالانج: مطبعة جامعة مولانا مالك إبراهيم، 2018م. 4. مجمع اللغة العربية بالقاهرة، المعجم الوسيط، مصر: مكتبة الشروق الدولية، 2011 م. 5. نبيل عبد السلام هارون، المعجم الوجيز، مصر: وزارة التربية والتعليم، 1994 م.

ARABIC LANGUAGE II: INTERMEDIATE READING AND WRITING (20000011A05)

Module designation	Arabic Language II: Intermediate Reading and Writing
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	TIM PKPBA
Language	Indonesian; Arabic
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Group Discussion 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-01 Students are able to adapt academic norms and ethics in the implementation of science and technology in religious, social, national, and state life based on Islamic values. PLO-06 Students are able to implement Islamic knowledge, integration of Islam, and science as a scientific paradigm PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO-051 Student are able to apply academic norms and ethics based on the character of ulul albab in Arabic 2. CO-056 Student are able to analyze a scientific paradigm in Arabic 2. CO-058 Student are able to disseminate the results of scientific studies in oral and written communication according to Arabic language rule.
Content	The study material comes from Al-'Arabiyah Lil Hayah (ALH) which includes: *Al-Ta'aruf, Al-Usrah, Al-Sakan, Al-Ansyitah Al-Yaumiyah, Al-Dirasah, Al-Hiwayaat, Al-Amal dan Ar-Rihlah*
Examination forms	Oral Presentation
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Hamid, Muhammad Abdul dkk. 2018. Al Arabiyah lil Hayah,. Malang: UIN Maliki Press. Buku 1 dan 2 2. Hamid, Muhammad Abdul dkk. 2018. Kamus al-musa'id li Al Arabiyah lil Hayah, Malang: UIN Maliki Press Additional : 1. محمود إسماعيل صيني، وناصف مصطفى عبد العزيز، ومختار الطاهر حسين، العربية للناشئين، المملكة العربية السعودية: إدارة الكتب المدرسية، وزارة المعارف، 1403 هـ. 2. محمد بن عبد الرحمن آل الشيخ (مشرف)، العربية بين يديك، الرياض-المملكة العربية السعودية: العربية للجميع، 1435 هـ. 3. محمد عبد الحميد، ومحمد عبد الله حارس، ودانيال حلمي، معجم العربية للحياة، مالانج: مطبعة جامعة مولانا مالك إبراهيم، 2018م. 4. مجمع اللغة العربية بالقاهرة، المعجم الوسيط، مصر: مكتبة الشروق الدولية، 2011 م. 5. نبيل عبد السلام هارون، المعجم الوجيز، مصر: وزارة التربية والتعليم، 1994 م.

ARABIC LANGUAGE III: ADVANCED LISTENING AND SPEAKING (20000011A06)

Module designation	Arabic Language III: Advanced Listening and Speaking
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	TIM PKPBA
Language	Indonesian ; Bahasa Arab
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Group Discussion 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-01 Students are able to adapt academic norms and ethics in the implementation of science and technology in religious social, national, and state life based on Islamic values PLO-06 Students Able to implement Islamic knowledge, integration of Islam, and science as a scientific paradigm PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.
CO	CO-061 Student are able to apply academic norms and ethics based on the ulul albab character in Arabic 3. CO-066 Student are able to analyze a scientific paradigm in Arabic 3. CO-068 Student are able to disseminate the results of scientific studies in oral and written communication according to Arabic language rules 3.

Content	The study material comes from Al-'Arabiyah Lil Hayah (ALH) which includes: *Al Mawasim, fi Al-Suq, fi Al Masjid, fi Al Maktabah, Al Tarbiyah wa Al Ta'lim fi Indonesia, Al Ma'had, Al Munasabat dan Al Ulama' fi Indonesia.*
Examination forms	Paper Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Hamid, Muhammad Abdul dkk. 2018. Al Arabiyah lil Hayah,. Malang: UIN Maliki Press. Buku 1 dan 2 2. Hamid, Muhammad Abdul dkk. 2018. Kamus al-musa'id li Al Arabiyah lil Hayah, Malang: UIN Maliki Press Additional : 1. محمود إسماعيل صيني، وناصف مصطفى عبد العزيز، ومختار الطاهر حسين، العربية للناشئين، المملكة العربية السعودية: إدارة الكتب المدرسية، وزارة المعارف، 1403 هـ. 2. محمد بن عبد الرحمن آل الشيخ (مشرف)، العربية بين يديك، الرياض-المملكة العربية السعودية: العربية للجميع، 1435 هـ. 3. محمد عبد الحميد، ومحمد عبد الله حارس، ودانيال حلمي، معجم العربية للحياة، مالانج: مطبعة جامعة مولانا مالك إبراهيم، 2018م. 4. مجمع اللغة العربية بالقاهرة، المعجم الوسيط، مصر: مكتبة الشروق الدولية، 2011 م. 5. نبيل عبد السلام هارون، المعجم الوجيز، مصر: وزارة التربية والتعليم، 1994 م.

ARABIC 4 (20000011A07)

Module designation	Arabic 4
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	TIM PKPBA
Language	Indonesian; Bahasa Arab
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-01 Students are able to adapt academic norms and ethics in the implementation of science and technology in religious social, national, and state life based on Islamic values PLO-06 Students are able to implement Islamic knowledge, integration of Islam, and science as a scientific paradigm PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science
CO	CO-071 Student are able to apply academic norms and ethics based on the ulul albab character in Arabic 4. CO-076 Student are able to analyze a scientific paradigm in Arabic 4. CO-078 Student are able to disseminate the results of scientific studies in oral and written communication according to Arabic language rules.

Content	The study material comes from Al-'Arabiyah Lil Hayah (ALH) which includes: *Al Fusul, Al Suuq, Al Masjid, Al Maktabah ,Al Tarbiyah wa al ta'lim Fi Indonesia, Al Ma'had, Al Munasabat dan Al Ulama' Fi Indonesia.*
Examination forms	Paper Test ; Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Hamid, Muhammad Abdul dkk. 2018. Al Arabiyah lil Hayah,. Malang: UIN Maliki Press. Buku 1 dan 2 2. Hamid, Muhammad Abdul dkk. 2018. Kamus al-musa'id li Al Arabiyah lil Hayah, Malang: UIN Maliki Press Additional : 1. محمود إسماعيل صيني، وناصف مصطفى عبد العزيز، ومختار الطاهر حسين، العربية للناشئين، المملكة العربية السعودية: إدارة الكتب المدرسية، وزارة المعارف، 1403 هـ. 2. محمد بن عبد الرحمن آل الشيخ (مشرف)، العربية بين يديك، الرياض-المملكة العربية السعودية: العربية للجميع، 1435 هـ. 3. محمد عبد الحميد، ومحمد عبد الله حارس، ودانيال حلمي، معجم العربية للحياة، مالانج: مطبعة جامعة مولانا مالك إبراهيم، 2018م. 4. مجمع اللغة العربية بالقاهرة، المعجم الوسيط، مصر: مكتبة الشروق الدولية، 2011 م. 5. نبيل عبد السلام هارون، المعجم الوجيز، مصر: وزارة التربية والتعليم، 1994 م.

ENGLISH LANGUAGE 1 (20000011A08)

Module designation	English Language I
Semester(s) in which the module is taught	3th Semester
Person responsible for the module	TIM PKPBI
Language	Indonesian ; English
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 3 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 3. Private learning : 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-3 Students are able to encourage technopreneurship founded on Islamic principles by applying rational, methodical, creative, and autonomous thinking in science and technology PLO-8 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science
CO	CO-081 Student are able to apply systematic thinking in using English. CO-082 Student are able to disseminate the results of scientific studies in oral and written communication according to English rules.

Content	1. Reading (a poster for exam candidates, an application form, a study timetable, online course introduction, social media posts, an email about studying in a university, and an email to congratulate a friend). 2. Writing (schedule, announcement, email, personal message, advertisement, review, taking notes, etc). 3. Grammar (word recognition: noun, verb, adjective, pronoun, adverb, preposition, determiner, conjunction, punctuation), (phrase recognition: noun phrase, verb phrase), (sentence recognition: nominal sentence), tenses (simple present tense , present continuous tense, past tense, simple future tense).
Examination forms	Paper Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. www.learnenglish.britishcouncil.org 2. https://learnenglishteens.britishcouncil.org 3. Seaton, A & Mew, Y, H. (2007). Basic English Grammar for English Language Learners book 1. The United States: Saddleback Educational Publishing. 4. Hyland, Ken. 2003. Second Language Writing. Cambridge: Cambridge University Press. 5. Richards, J. C., Jonathan, H., & Proctor, S. (1997). New interchange 1: English for international communication. New York: Cambridge University Press. Additional : 1. Azar, Betty Schramper. (2010). Understanding and Using English Grammar. New Jersey: Prentice-Hall, Inc. 2. Clarke, M. A., Dobson, B. K. & Silberstein, S. (1996). Choice readings. Michigan: The University of Michigan Press. 3. Eastwood, John. (2000). Oxford Guide to English Grammar. New York: Oxford University Press. 4. Leech, Geoffrey. 2000. English Grammar for Today. New York: Macmillan Press. 5. https://www.englishclub.com/

ENGLISH LANGUAGE II (20000011A09)

Module designation	English Language II
Semester(s) in which the module is taught	4^{th} Semester
Person responsible for the module	TIM PKPBI
Language	Indonesian ; English
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 3 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	4. Lectures : 3 x 50 = 150 minutes per week. 5. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 1. Private learning : 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Prerequisite Course: English Language I (20000011A08)
Module objectives/intended learning outcomes	PLO-3 Students are able to encourage technopreneurship founded on Islamic principles by applying rational, methodical, creative, and autonomous thinking in science and technology PLO-8 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science
CO	CO-091 Student are able to apply systematic thinking in using English. CO-092 Student are able to disseminate the results of scientific studies in oral and written communication according to English rules.

Content	1. Reading (environment, digital habits across generation, spotting fake news, digital footprints, social media influencer, travel guide, job adverts, planning an event, a conference programme, innovation in business, the sharing economy, skills for 21 century workplace, a book review). 2. Writing (environment, digital habits across generation, spotting fake news, digital footprints, social media influencer, travel guide, job adverts, planning an event, a conference programme, innovation in business, the sharing economy, skills for a 21 century workplace, a book review). 3. Listening and Speaking (global issues, digital toxic podcasts, news, online safety, music and social media, traveling abroad, etc.) 4. Grammar (sentence construction, subject-verb agreement, appositives, derivation, conjunction, adjective clause, noun clause, participle, passive voice, parallelism, degrees of comparison, elliptical sentences, conditional sentences)
Examination forms	Paper Based Test ; Oral Presentation test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. www.learnenglish.britishcouncil.org 2. https://learnenglishteens.britishcouncil.org 3. Seaton, A & Mew, Y, H. (2007). Basic English Grammar for English Language Learners book 1. The United States: Saddleback Educational Publishing. 4. Hyland, Ken. 2003. Second Language Writing. Cambridge: Cambridge University Press. 5. Richards, J. C., Jonathan, H., & Proctor, S. (1997). New interchange 1: English for international communication. New York: Cambridge University Press. Additional : 1. Azar, Betty Schramper. (2010). Understanding and Using English Grammar. New Jersey: Prentice-Hall, Inc. 2. Clarke, M. A., Dobson, B. K. & Silberstein, S. (1996). Choice readings. Michigan: The University of Michigan Press. 3. Eastwood, John. (2000). Oxford Guide to English Grammar. New York: Oxford University Press. 4. Leech, Geoffrey. 2000. English Grammar for Today. New York: Macmillan Press. 5. https://www.englishclub.com/

PHILOSOPHY OF SCIENCE (20000011A010)

Module designation	Philosophy of Science
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Agus Budianto, MA, Dr. A. Barizi
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-1 Students are able to adapt academic norms and ethics in the implementation of science and technology in religious social, national, and state life based on Islamic values PLO-6 Students are able to implement Islamic knowledge, integration of Islam, and science as a scientific paradigm
CO	CO-101 Student are able to apply religious human values based on the character of ulul albab. CO-102 Student are able to implement the concept of integration of Islam and science as a scientific paradigm in the philosophy of science.

Content	1. Philosophy and Objects of Philosophical Study 2. Science, Philosophy of Science and Areas of Study in the Philosophy of Science 3. Scientific thinking methods (Inductive and deductive) 4. Function of scientific thinking (analysis and synthesis) 5. Scientific truth, theories of truth and the nature of scientific truth 6. History of the development of science and philosophy of science in Ancient Greece, the Middle Ages and the Renaissance. 7. Development of science and philosophy of science in the Modern and Contemporary Era 8. Study of the ontology of science 9. Study of the Epistemology of Science from a Western Perspective 10. Epistemological Studies in Islamic Perspective 11. Axiological Study of Science 12. Classification and Hierarchy of science 13. Islamization of knowledge based on ontology, epistemology and axiology. 14. Integration of Islam and Science
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Adib, Mohammad. 2011. Filsafat Ilmu Ontologi, Epistemologi, Aksiologi, dan Logika Ilmu Pengetahuan. Yogyakarta: Pustaka Pelajar. 2. Jujun S. Suriasumantri. 2005. *Filsafat Ilmu: Sebuah Pengantar Populer.* Jakarta: Pustaka Sinar Harapan. 3. Bakhtiar, Amsal. *Filsafat Ilmu*, 2004. Jakarta: Rajawali Press. 4. Liang Gie. Filsafat Ilmu. 1991. Yogyakarta. Studi Ilmu Teknologi. 5. In'am Esa, Filsafat Ilmu. Malang: UIN Pess. 6. Zainuddin, Filsafat Ilmu. Malang: UIN Press 7. Al-Faruqi, Ismail Razi. 1988. *Islamisation of Knowledge: General Principles and Work Plan Herndon*. Washington VA IIT. 8. Golshani, Mehdi. 2011. *The Holy Qur'an and Sciences of Nature*. Tehran: Islamic Propagation Organization. 9. Jujun S. Suriasumantri, 2012. *Ilmu dalam Perspektif.* Jakarta: Yayasan Pustaka Obor Indonesia. 10. O'hear, Anthony. 1989. *Introduction to the Philosophy of Science*. New York: Oxford. 11. Osman Bakar. 1992. *Classification of Knowledge in Islam*. Kuala Lumpur: Institute for Policy Research. 12. Soelaiman, A. Darwis. 2019. *Filsafat Ilmu Pengetahuan Perspektif Barat dan Islam*. Aceh: Bandar Publishing. 13. Tim Dosen Filsafat Ilmu. 2001. *Filsafat Ilmu: Sebagai Dasar Pengembangan Ilmu Pengetahuan.* Yogyakarta: Liberty Yogyakarta.

HISTORY OF ISLAMIC CIVILIZATION (20000011A11)

Module designation	History of Islamic Civilization
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Umaiyatus Syarifah, MA
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-1 Students are able to adapt academic norms and ethics in the implementation of science and technology in religious social, national, and state life based on Islamic values PLO-3 Students are able to encourage technopreneurship founded on Islamic principles by applying rational, methodical, creative, and autonomous thinking in science and technology PLO-6 Students are able to implement Islamic knowledge, integration of Islam, and science as a scientific paradigm.

CO	CO-111 Students are able to uphold human values in social, national and state life. CO-112 Students are able to apply logical thinking in understanding the history of Islamic civilization. CO-113 Students are able to master Islamic knowledge as a scientific paradigm in the history of Islamic civilization.
Content	1. Understanding the history of Islamic Civilization as a Science, 2. Basics of Civilization and Periodization of Islamic Civilization 3. Pre-Islamic Arab Civilization 4. Islamic Civilization During the Prophet's Period: 1) Makkah Phase: Da'wah, hijrah, etc. 2) Medina Phase: Formation of social, societal, political systems, etc 5. Islamic Civilization during the Khulafaur Rashidin Period 6. Umayyad Dynasty (661 AD-750 AD); government system, progress and setbacks 7. Abbasid dynasty (750 AD-1258 AD), progress, decline (era of disintegration/dynasties that liberated themselves from Baghdad) 8. Crusade (1094 AD-1344 AD); Periodization of the crusades, their causes and influence 9. Mongol invasion (1209 AD); cause and effect 10. Civilization of the Ottoman (1281 AD-1924 AD), Syafawiyah (1501-1722 AD) and Mughal (1526-1707) Turkish dynasties (in India). 11. Indonesian Islamic civilization during the Wali Songo period 12. The Era of the Decline of Islamic Civilization and the Modern Era; The Revival of Islamic Civilization 13. Islamic scientific responsibility (in the Biology Department) 14. History of the Development of Biological Sciences in Islamic Civilization
Examination forms	Paper Test, Oral Presentation Test

Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main :
	Main : 1. Hasymy Sejarah Masuk dan Berkembangnya Islam di Indonesia 2. A.Mukti Ali, Ensiklopedi Islam di Indonesia 3. A.Syalabi, Sejarah dan Kebudayaan Islam:Imperium Turki Usmani 4. Abu al-Hasan Ali al-Nadwi,Islam Membangun Peradaban Dunia 5. Ahmad Amin, Faj al-Islam 6. Ahmad Amin, Islam dari Masa ke Masa 7. Ahmad Rifa'i Hasan, Warisan Intelektual Islam Indonesia 8. Awal Kebangkitan Mataram Masa Pemerintahan Senapati 9. Azyumardi Azra, Perspektif Islam di Asia Tenggara 10. B.J.Boland, Pergumulan Islam di Indonesia 11. Badri Yatim, Sejarah Peradaban Islam, Jakarta Rajawali Press, 1996 12. Carl. Brockelmann History of the Islamic Peoples 13. Clifford Geertz, Santri, Abangan dan Priyayi 14. Hasan Ibrahim Hasan, Sejarah dan Kebudayaan Islam 15. Hasan Ibrahim Hasan, Tarikh al-Islam al-Siyasi wa al-Dini wa al-Tsaqafi wa al-Ijtima'i 16. Hasan Ibrahim, Sejarah dan Kebudayaan Islam, Yogyakarta: Kora Kembang, 1989 17. J.L. Bacharach, A. Middle East Studies Handbook 18. Jr. Arthur Goldschmidt, A Concise History of the Middle East 19. Jurji Zaidan, Tarikh al-Tamaddun al-Islami. 20. M. Yahya Harun, Perang Salib dan Pengaruh Islam di Eropa 21. Muhammad Hussain Haikal, Sejarah Hidup Muhammad 22. Nurcholish Madjid, Khazanah Intelektual Islam, 23. Philip K. Hitti, History of the Arab Islam Additional : 1. Azyumardi Azra, Historiografi Islam Kontemporer: Wacana Aktualitas dan Aktor Sejarah, Jakarta: PT Gramedia Pustaka Utama, 2002. 2. Badri Yatim, Sejarah Peradaban Islam: Dirasah

	Islamiyah II, Jakarta: PT Rajagrafindo Persada, 2003. 3. Dedi Supriyadi, Sejarah Peradaban Islam, Bandung: Pustaka Setia, 2009. 4. Jaih Mubarak, Sejarah Peradaban Islam, Bandung: CV Pustaka Islamika, 2008. 5. K. Ali, Sejarah Islam (Tarikh Pramodern), Jakarta: PT Rajagrafindo Persada, 2003. 6. M. Abdul Karim, Islam Nusantara, Yogyakarta: Pustaka Book Publisher, 2007. 7. M. Abdul Karim, Sejarah Pemikiran dan Peradaban Islam, Yogyakarta: Pustaka Book Publisher, 2007. 8. Moh Nurhakim, Sejarah dan Peradaban Islam, Malang: UMM Press, 2004. 9. Musyrifah Sunanto, Sejarah Peradaban Islam Indonesia, Jakarta: PT Rajagrafindo Persada, 2005. 10. Kamaruzzaman Sutaman, Wajah Baru Islam di Indonesia, (Yogyakarta:UII Press), 2004.

THEOSOPHY (20000011A12)

Module designation	Theosophy
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Umaiyatus Syarifah, MA
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-1 Students are able to adapt academic norms and ethics in the implementation of science and technology in religious social, national, and state life based on Islamic values PLO-2 Students are able to develop a responsible attitude, spirit of independence, and entrepreneurship according to their field of expertise. PLO-6 Students are able to implement Islamic knowledge, integration of Islam, and science as a scientific paradigm.
CO	CO-121 Student are able to implementation of religious science and technology based on the character of ulul albab. CO-122 Student are able to apply logical thinking in understanding theosophy. CO-123 Student are able to implement the concept of integration of Islam and science as a scientific paradigm in theosophy.

Content	1. Theosophy: basic concepts, and scope 2. Islamic theology: understanding, history and causal factors and the urgency of studying Islamic theology in the modern era 3. Islamic theological schools: Khawarij and Murjiah 4. Islamic theological schools: Shi'ism, history and teachings 5. Islamic theological schools: Mu'tazilah, history and teachings 6. Islamic theological schools: Jabariyah and Qadariyah, history and teachings 7. Islamic theological schools: Sunni, history and teachings 8. Sufism: Definition, history, urgency of studying Sufism in the modern era 9. Maqamat: definition, scope and levels of ahwal, first level: repentance, inabah and taubah 10. Maqamat levels: al-zuhud, al-shabr, al-faqr, al-tawadlu' 11. Maqamat levels: al-taqwa, al-tawakkal, al-ridla, 12. Ahwal; definition, scope and initial level 13. The teachings of Sufism 'amali 14. Contemporary Islamic theology and Sufism in the challenge of moderation
Examination forms	Paper Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Mansur bin Rasyid al-Tamimi, 2014, al-`Iṣmatu Fī Ḍow’I `Aqīdati Ahli as-Sunnati Wa Al-Jamā`ati, Cet. I, Riyad: Maktabah ar-Rusyd 2. Abdulloh Urwani, 1983, Uṣūlu al-`Aqō’idi al-Islāmi, Cet. III, Dimsyiq: Darul Qolam 3. Qohton Abdurrohman ad-Duri, 2016, al- Aqīdati al-Islāmiyyati Wa Mażāhibuhā, Cet. VI, Lebanon: Books-Publisher 4. Adil Haidari, Seri Disertasi dengan judul al-Qowā`idu al-`Aqdiyyatu `Inda Ahlis-Sunnati wa al-Jamā`ati, Saudi Arabia: Universitas Ummul Quro 5. Muhammad Abu Zahrah, tt, Tarīkhu al-Mażāhibu al-Islāmiyyatu, Qohiroh: Darul Fiker al-Arobi 6. Yusuf at-Torif, 2009, Tadwīnu `ilmu al-`Aqīdati `Inda Ahli as-Sunnati wa al-Jamā`ati, Cet. I, Riyad: Maktabah Malik bin Fahed 7. Mahmud Syafii, 2001, al-Madkholu Ilā Dirōsati `Ilmi al-Kalāmi, Cet. II, Pakistan: Idarotul al-Quran Wal Ulum al-Islamiyah 8. Amin Nasihun, 2009, Dari Teologi menuju Teoantropologi pemikiran teologi pembebasan Asghar Ali Engineer, Walisongo Press, Semarang. 9. Suyono, Yusuf, 2008, Reformasi Teologi, Muhammad Abduh vis a vis Muhammad Iqbal, Rasail Media Group, Semarang. 10. Hanafai, A., 1980, Theology Pengantar Islam, Pustaka al-Husna, Jakarta. 11. Santosa, Budi, tt, Membumikan Ajaran-ajaran Langit Pendalaman Aspek Aqida dan Akhlak, Wisdom Institute. Yogyakarta. 12. Nasution Harun, Teologi Islam Aliran-aliran Sejarah Analisa Perbandingan, UI Press, Jakarta. 13. Asmuni, Yusran, 1994, Pertumbuhan dan Perkembangan Berfikir dalam Islam, al-Ikhlas, Surabaya.9. 14. Harun Nasution, Teologi Islam: Aliran-Aliran Sejarah, Analisa Perbandingan, Jakarta: UI Press, 1986. 15. Ahmad Yulianto, Ikhtiar Menelisik Ajaran Teologi dan Tasawuf, Malang: Pustaka Peradaban 2023.

	16. Islam Ditinjau dari Berbagai Aspeknya jilid 1 dan 2. Jakarta : UI Press, 1986. 17. Islam Rasional. Bandung: Penerbit Mizan, 1998. 18. Muhammad Imaroh, 2006, Fitnatu at-Takfīri Baina as-Syī’ati Wa al-Wahhābiyyati Wa as-Sufiyyati, Qohiroh: Wuzarotul Awqof: al-Majlis al’A’la Lis Syuun ad-Diniyah. 19. Muhammad Abduh, 1994, Risālatu at-Tauhīdi, Cet. I, Beirut: Darus Syuruq. 20. Muhammad Abduh, 1993, al-A’mālu al-Kāmilatu, Cet. I, Beirut: Darus Syuruq. 21. Muhammad Amman al-Jami, 2004, al- Aqīdatu al-Islāmiyyatu Wa Tārīkhuhā, Qohiroh: Darul Minhaj. 22. Hasyim Asyari, 1986, Risālatu Ahlus Sunnah Wa al-Jamā`atu, Tebu Ireng, Jombang: Maktabah Turos al-Islami. 23. Sirojuddin Abbas, 2006, I’tiqad Ahlus Sunnah Wal Jama’ah, Cet. XXXII, Jakarta: Pustaka Tarbiyah. 24. Mamduh al-Harbi, 2009, Mujmalu ‘Aqō’idi as-Syī’ati Fi Mīzāni Ahlus Sunnah Wa al-Jamā`ati, Cet. I, ..: Matbaah al-Umroniyah. 25. Aisyah Yusuf al-Mannai, 1992, Uṣūlu al-`Aqīdati Baina al-Mu'tazilah Wa as-Syī`ati, Cet. I, Qatar: darus Tsaqofah. 26. Iwad bin Abdillah, 1995, al-Mu’tazilatu Wa Uṣūluhum al-Khomsatu, Cet. II, Riyad: Maktabah ar-Rusyd. 27. Ahmad zarruq al-Fasi, Igtināmu al-Fawā’idi Fi Syarhi Qowā’idi al-‘Aqō’idi, Kuwait Darud Diya’. 28. Murod Abdillah, 2006, Sa`ādatu al-`Anāmi Fi Syarhu `Aqīdati al-Awāmi, Cet. I, Son’a’: Darul Kutub. 29. Rois Imron Rosi, 2022, Teosofi: Pengantar Teologi Islam dan Tasawuf, Malang: Madza Media. Additional : 1. Abduh Gholib, 1992, Mafhūmu at-Taṣawwufu, Cet. I, Beirut: Darul Jili. 2. Ahmad Zaruq, 2005, Qowā`idu at-Taṣawwufu, Cet. I, Beiru: Darul Kutub al-Ilmiyah. 3. Ibrohim Yasin, 2002, al-Madkholu Ilā at-Taṣawwufi al-Falsafi, Muntada Suwaril Azbikiyah. 4. Abdul Bari an-Nadawi, 2003, Baina at-

	TaṣawwufuWa al-Hayāti, Cet. I, Dimsyiq: Maktabah al-Farobi. 5. Abu al-Wafa at-Taftazani, Madkholun Ilā at-Taṣawwufu al-Islmai, Cet. III, Qohiroh: Darus Tsaqofah. 6. Mahmud Sayyid Sobih, 2006, Hatta Lā Turomu Ru'yatan Nabī Fī al-Manāmi, Cet. I, Qohiroh: Darur Rukni Wa al-Maqomi. 7. Abdul Fattah al-Yafii, 2019, Ru'yatan Nabī Yaqẓotan, Cet. I, Yaman: Markazul Khoirot. 8. Abdul Qodir as-Syadzili, 2010, al-Kawākibu az-Zāhirotu, Cet. I, Qohiroh: Maktabah Tsaqofah ad-diniyah. 9. As-Suyuti, Tanwīru 1993, al-Halqi Fī Ru'yatin Nabī Wa al-Malaki, Cet. I, Qohiroh: Darul Amin. 10. Ibnu Arobi, al-Futūhātu al-Makiyyatu, Beiru: Darul Kutub al-Ilmiyah. 11. Mahmud Gorob, 1992, al-Hubbu Wa al-Mahabbatu Min Kalāmi Syaikhi al-Akbari Ibni Arobi, Cet. II, Dimsyiq_ Matbaah Katib al-Arobi. 12. Ibnu Arobi, 1998, Lawāzimu al-Hubbi, Cet. I, Dimsyiq: Darun Namir. 13. Al-Ghazali, 2011, Ihyā' `Ulūmii ad-Dīni, Cet. I, Jeddah: Darul Minhaj. 14. Ahmad al-Kamsyakhonawi, Jāmi'u al-Uṣūli Fī al-Awliyāillahi, Surabaya: Matbaah al-Haromain i 15. Al-Qusyairi, 1989, ar-Risalatu al-Qusyairiyatu, Qohiroh: Darus Syuub. 16. Zakariya al-Anshori, 2000, Ihkāmu ad-Dilālati Alā Tahrīri ar-Risalaiu al-Qusyairiyati, Cet. I, Dimsyiq: Darun Nukman Li Ulum. 17. Al-Ghazali, 2018, al-Maqṣodu al-Asnā Fi Syarhi al-Asmā'I al-Husnā, Cet. I, Beirut: Darul Minhaj. 18. Al-Qusyairi, 2006, Syarhu al-Qusyairi Li al-Asmā'i Allōhi al-Husnā, Cet. I, Beirut: Darul Kutub al-Ilmiyah 19. Al-Qounuwi, 2012, Syarhu al-Asmā'I al-Husnā: Kitābun Fi Tauhīdi as-Syuhūdi Wa al-Ayyāni, Cet. I, Lebanon: Books Publisher. 20. Ibnu Barjan, 2010, Syarhu al-Asmā'i Allōhi al-Husnā, Cet. I, Beirut: Darul Kutub al-Ilmiyah Beirut: Darul Kutub al-Ilmiyah.

	21. Ibnu Taimiyah, 1983, al-Qowā`idu Fi al-Mu`jizāti Wa al-Karōmati, Cet. I, Ordon: Maktabatul Manar. 22. Al-Baqilani, Kitābu al-Bayāni `Ani al-Farqi Baina Fi al-Mu`jizāti Wa al-Karōmati Wa al-Hiyali Wa al-Kahānati Wa as-Sihri Wa an-Naronjāti, 1985, Beirut: Maktabh Syarqiyah.

STUDY OF THE QUR'AN AND AL-HADITH (20000011A13)

Module designation	Study of The Qur'an and Al-Hadith
Semester(s) in which the module is taught	3th Semester
Person responsible for the module	Dr. Umaiyatus Syarifah, MA
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-1 Students are able to adapt academic norms and ethics in the implementation of science and technology in religious, social, national, and state life based on Islamic values. PLO-6 Students are able to implement Islamic knowledge, integration of Islam, and science as a scientific paradigm.
CO	CO-131 Students are able to implement the value of religious science and technology based on the character of ulul albab. CO-132 Students are able to implement the concept of integration of Islam and science as a scientific paradigm in the study of the Koran and Al Hadith.

Content	1. Al-Quran and Hadith paradigm 2. The position of the Koran and Hadith in Islam 3. Asbab al-nuzul and Asbab al-Wurud al-Hadith 4. Codification of the Koran and Hadith 5. Methods and styles of interpretation of the Koran (tahlili, ijmali, muqaran, maudhui) 6. Hadith viewed in terms of quality and quantity 7. Scientific and Social Interpretation Methodology 8. Thematic Tafsir: The concept of anti-corruption from the perspective of the Koran and Hadith 9. Thematic Tafsir: Tolerance in the Perspective of the Al-Quran and Al-Hadith 10. Thematic Tafsir: Trust from the perspective of the Koran and Hadith 11. Thematic Tafsir: Environmental Conservation from the Perspective of the Al-Quran and Hadith 12. Thematic Tafsir: Metals in the Perspective of the Koran and Hadith 13. Thematic Tafsir: Geology in the Perspective of the Koran and Hadith 14. Thematic Tafsir: The Sea in the Perspective of the Koran and Hadith
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Abu al-Qasim Sulaiman ibn Ahmad al-Thabrani, al-Mu’jam al-Ausath. Kairo: Dar al-Haromain, 1415 H. 2. Abu al-Qasim Sulaiman ibn Ahmad al-Thabrani, al-Mu’jam al-Kabir, Tahqiq: Hamdi ibn Abd al-Majid al-Salafi . Al-Musil: Maktabah al-‘Ulum wa al-Hikam, 1983 3. Jalal al-Din al-Suyuthi, Jam’u al-Jawami’. Maktabah Syamilah 4. Jalal al-Din al-Suyuthi, Jami’ al-Ahadis. Maktabah Syamilah. 5. Jalal al-Din al-Suyuthi, al-Itqan fi Ulum al-Qur'an. Tahqiq: Muhammad Abu al-Fadhl Ibrahim. Mesir: Al-Haiah al-Misriyyah al-'Ammah. 1974 6. Muassasah Ali al-Bait al-Malikiyah li al-Fikr al-Islami, al-Kitab al-Jami’ li Fadhail al-Qur’an. Jordan: al-Muassasah, 2008. 7. Muhammad ibn Ismail Abu Abdillah al-Bukhari al-Ja’fy, al-Jami’ al-Shahih al-Mukhtashar, Tahqiq: Mustafa Dib al-Bugha. Bairut: Dar Ibn Kathir, 1987. 8. Muhammad ibn Yazid Abu Abdillah al-Qazwiniy, Sunan Ibnu Majah, Tahqiq: Muhammad Fuad Abd al-Baqi. Bairut: Dar al-Fikr 9. Muslim ibn al-Hajjaj Abu al-Husain al-Qusyairy al-Naisabury, Shahih Muslim, Tahqiq; Muhammad Fuad Abdu al-Baqy. Bairut: Dar Ihya al-Turath al-Araby 10. Nuruddin Ali ibn Abi Bakar al-Haithami, Majma’ al-Zawaid. Bairut: Dar al-Fikr, 1992. 11. Sulaiman ibn al-Asy’ath Abu Dawud al-Sajistani al-Azdi, Sunan Abu Dawud, Tahqiq; Muhammad Muhyiddin Abd al-Hamid, Bairut; Dar al-Fikr. 12. Jalaluddin Abdurrahmaan al-Suyuuty, Al-Itqaan fii ‘Uluum al-Qur’an. Kairo: Daar al-Hadiith. 1425. 13. Muhammad Huusen al-Dhahaby, Al-Tafsiir wa al-Mufassiruun. Kairo: Maktabah Wahbah. 2000. 14. Abdurrahman dan Elan Sumarna. Metode Kritik Hadits, Bandung: Rosdakarya, 2011. 15. Amin, Kamaruddin, Menguji Kembali Keakuratan Metode Kritik Hadis, Jakarta: Mizan, 2009. 16. Al-Ashbahani, Nu’aim Ahmad bin Abdullah bin

	Ahmad bin Ishaq. Musnad Mustakhraj 'ala Shahih Imam Muslim, Beirut : Darul Al Maktab al-ilmiyah, 2002. 17. Azami., M. M., Hadis Nabawi dan Sejarah Kodifikasinya. Terj. Ali Mustafa Ya'qub. Jakarta : Pustaka Firdaus, 1994. 18. Brown, Daniel. Menyoal Relevansi Sunnah dalam Islam Modern, Bandung: Mizan, 2000. 19. Ismail, M. Syuhudi.Metodologi Penelitian Hadis Nabi. Jakarta: Bulan Bintang, 1992. 20. Khairuman, Badri. Otentisitas Hadis: Studi Kritis atas Kajian Hadis Kontemporer, Bandung: Rosdakarya, 2004. Additional : 1. Muhammad al-Ghazali, Studi Kritis atas hadis Nabi saw antara tekstual dan kontekstual, terj. Muhammad al-Baqir (Bandung; Mizan, 1996. 18. 2. Muhammad Yusuf, Metode dan aplikasi pemaknaan hadis, Yogyakarta; Teras, 2009. 19. 3. Munawwir (al), Warson, Kamus al-Munawwir . Krapyak; PP. al-Munawwir, 1984. 20. 4. Qardhawi, Yusuf, pengantar studi hadis, terj. Agus Suyadi . Bandung ; Pustaka Setia, 2007. 21. 5. Ulama'i, Hasan Asyari, Metode Tematik Memahami Hadis Nabi . Semarang ; Walisongo Press, 2010. 22. 6. Zuhdi Masfuk, Pengantar Ilmu Hadits, Surabaya: PT. Bina Ilmu, 1993. 23. 7. Wachid Abdul, Hadits Semenjak Disabdakan Sampai Dengan Dibukukan, yogyakarta: Fajar Pustaka, 2010. 24. 8. Zarkasih, Dr .2011 . Pengantar Studi Hadis .Yogyakarta : Aswaja Pressindo. 26. 9. Abdul Mahdi bin abdul qadir bin abdul hadi, Abu Muhammad. 1994 . Metode Takhrij Hadis .Semarang : Dina Utama Semarang. 27. 10. Syuaib H Muhammad, Tafsir Tematik Konsep Alat Bantu Dan Contoh Penerapannya, Malang: UIN Maliki Press, 2013. 29. 11. Imamuddin, Peranan Air dalam perspektif al-Quran, elhayah 2012 12. Imamuddin, Lingkungan dan Pelestariannya,

	elHayah 2012 13. Andi Rosadisastra, metode tafsir sains dan social, Jakarta: Amzah 2016 14. Umaiyatus Syarifah, Methods and principles of scientific exegesis, Ulul Albab, Vol. 2 2020

STUDY OF FIQH (20000011A14)

Module designation	Study of Fiqh
Semester(s) in which the module is taught	3th Semester
Person responsible for the module	Lecturer of Integration Study
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-01 Students are able to adapt academic norms and ethics in the implementation of science and technology in religious, social, national, and state life based on Islamic values. PLO-06 Students are able to implement Islamic knowledge, integration of Islam, and science as a scientific paradigm.
CO	CO-141 Students are able to implement religious academic norms and ethics based on the ulul albab character. CO-142 Students are able to analyze a scientific paradigm in the study of fiqh.

Content	1. Basic concepts of fiqh: meaning, object of study, objectives and position in Islam 2. Sources and postulates of muttafaq fiqh (Al-Qur'an Hadith Ijma' and Qiyas). 3. Mukhtalaf sources and propositions of Fiqh (Istishab, Maslahah Mursaya, Sadd al-Dzari`ah, Urf, Istihsan, Qaul Shahabi and Syar'un man Qablana) 4. Principles and Characteristics of Fiqh (syariah) 5. Maqashid al-Syari'ah (the purpose of enshrining Islamic law) and its application in the fiqh thinking of fiqh experts 6. Fiqh divisions and their respective scopes (ibadah, muamalah, munakahat, jinayat, siyasah and environmental fiqh). 7. History of the growth of fiqh (the time of the Prophet, companions, tabi'in and madhhab imams) 8. History of the decline of fiqh and the period of revival and renewal of fiqh. 9. Ijtihad and fatwa; classification of ijtihad and mujtahid; The position of ijtihad and fatwa in Islam 10. Biographies of Madzhab Imams in fiqh (Imam Abu Hanifah, Imam Malik, Imam Syafi'i and Imam Ahmad bin Hanbal). 11. Al-Qawa'id al-Fiqhiyyah al-Khamsah (five basic rules in fiqh) 12. The relationship between Fiqh and Positive Law in Indonesia 13. The influence of Fiqh in Islamic Law legislation in Indonesia; Islamic Law materials included in National Law legislation 14. Results of istinbath (excavation of Islamic law) of the Islamic Law Fatwa Institute in Indonesia.
Examination forms	Paper Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Abd al-Hamid Kisyik, Ahmad . al-Hadits Bayn al-Ijtihad wa al-Ijtira’ Kairo: al-Zahra. 1977. 2. Abd al-Karim, Fathiy, al-Sunnah tasyri’ Lazim wa Daim, Kairo: Maktabah Wahbah, 1985. 3. Abd al-Khaliq, Abd al-Ghani. Hujjiyat al-Sunnah, Beirut: dar al-Qur’an al-Karim. 1986. 4. Abd al-Qadir, Ali Hasan Nazharah ‘Ammah fi Tarikh al-Fiqh al-Islami. Kairo: Dar al-Kutub al-Arabiyah, 1965 5. Abd al-Rahman, Jalal al-Din , al-Sunnah Ghayah al-Wushul ila Daqaiq Ilmi al-Ushul, tt: al-DzahAbi, 1999. 6. Abd al-Raziq, Ali. Al-Islam wa Ushul al-Hukmi. Beirut: al-Hayah. 1878. 7. Abu Rayyah, Mahmud. Adlwa’ ‘ala al-Sunnah al Muhammadiyah. Kairo: dar al-Ma’arif. T.th. 8. Ahyani, Shidqi, 2021, Zakat dan Upaya Penanggulangan Kemiskinan dalam Perspektif Alquran, Jurnal Hukum dan Ekonomi Syariah, Volume 4, No. 2, http://jurnalnasional.ump.ac.id/index.php/JHES/article/view/11159 9. Hakim, Abdul Hamaid, al-Sullamu fi Ushul al-Fiqh, tt. 10. Hasaballa, Ali, Ushul al-Tasyri al-Islami , Mesir : Dar al-Ma’rifat, 1964. 11. Hasan Khalil, Rasyad, Tarikh Tasyri’: Sejarah Legislasi Hukum Islam, Jakarta: Bumi Aksara, 2009 12. Hasan, M. Ali, Masail Fiqhiyah Al-Haditsah, Jakarta : Rajawali Pers, 1995. 13. Hasan, M. Ali, Berbagai Macam Transaksi dalam Islam. Jakarta : Rajawali Pers, 2003. 14. Khallaf, Abdul Wahab, Ilmu Ushul al Fiqih, Kuwait: An-Nasyr, 1978. 15. Khallaf , Abdul Wahhab, Kaidah-Kaidaah Hukum Islam: Ilmu Ushul Fiqh (terj.) , Jakarta: PT Raja Grafindo Persada, 2002. 16. Al-Qardhawi, Yusuf, Fiqih Zakat, Mu`assasah al Risalah, Beirut, cet. XXIV, 1997. 17. Sabiq, Sayid, Fiqih al Sunnah, Beirut : Dar al Fikr, 1983.

	18. Shahih, Muhammad Adib, Tafsir al-Nushush fi fiqih al-Islami. Beirut: al-Maktabah al-Islami, 1984. 19. Al-Shalih, Shubhi, Ma'alim al-Syari'ah al-Islamiyyah. Bairut: Dar al-Ilm al-Malayin, 1982. 20. Al-Shiddiqi, Hasbi, Pengantar Fiqih Muamalah, Pustaka Rizki Putra, Semarang, 1999. 21. Sudarsono, Pokok-pokok hukum Islam, Jakarta : Rineka Cipta, 2001. 22. Al-Syatibi, al-Muwafaqat fi Ushul al-syari'ah, Juz II. Beirut: Dar al-Kutub al-Ilmiah, t, th. 23. Al-Syaukani, Muhammad bin Ali Muhammad , Irsyad al- al-Fuhul ila Tahqiq min 'Ilm al-Ushul Beirut: Dar al-Fikr, t.th. 24. Syuhbah, Abu, Difa' An al-Sunanah. Mesir: Maktabah al-sunnah. 1989 25. Zahrah, Muhammad Abu, al-Syafi'i Hayatuh wa 'Ashrh 'Arauh wa Fiqhuh. Kairo: Dar Fikr al-Arabi. 1996. 26. Zahrah, Muhammad Abu. Tarikhal-Madzahib al-Islamiyah Fi al-Siyasah wa al-'Aqaid wa Tarikh al-Madzahib al-Fiqhiyah. Kairo: Dar al-Fikr. 27. Zaidan, Abdul Karim, Madkhal li Dirasat al Syari`ah al Islamiyah, Mu`assasah al Risalah, Syria, 1993. 28. Zainuddin ibn Abdul Aziz, Fathul Mu'in, Surabaya: Maktabah Syekh Salim, tt. 29. Zuhaili, Wahbah, al Fiqh al Islami wa Adillatuhu. Syiria: Dar al Fikr, cet. III, 1989. 30. Zuhdi, Masjfuk, Masail fiqhiyah: kapita selekta hukum Islam. Jakarta : Gunung Agung, 1994.

KKM (20000011A15)

Module designation	KKM
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	TIM Pengabdi
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Inquiry Based Learning 170" per week X 28 time per Semester
Workload (incl. contact hours, self-study hours)	170 minutes per week
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Prerequisite Course: 100 credits
Module objectives/intended learning outcomes	PLO-01 Students are able to adapt academic norms and ethics in the implementation of science and technology in religious, social, national, and state life based on Islamic values. PLO-03 Students are able to encourage technopreneurship founded on Islamic principles by applying rational, methodical, creative, and autonomous thinking in science and technology. PLO-06 Students are able to implement Islamic knowledge, integration of Islam, and science as a scientific paradigm.
CO	CO-151 Students are able to prepare activity plans [KKM based on scientific foundations in accordance with the scientific field student. CO-152 Students are able to connect theory with real practice in the field. CO-153 Students are able to communicate with partners and show professional performance during activities with KKM partners.

Content	1. Preparation: search for KKM partners, KKM administration, communication with partners, KKM briefing 2. Search for scientific literature as a theoretical basis for implementing KKM 3. Preparation of KKM proposals 4. Implementation of KKM in partners. Interpretation and analysis of observation results and special tasks at KKM partners 5. Presentation of KKM in scientific writing 6. Presentation of KKM results orally
Examination forms	Oral Presentation Test
Study and examination requirements	- Final exams
Reading list	1. Buku Panduan KKM 2. Buku Pedoman Pendidikan.

PKL (22060411C01)

Module designation	PKL
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Utiya Hikmah, M.Si.
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Inquiry Based Learning 170" per week X 28 time per Semester
Workload (incl. contact hours, self-study hours)	170 minutes per week
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: 100 credits SKS
Module objectives/intended learning outcomes	PLO-1 Students are able to adapt academic norms and ethics in the implementation of science and technology in religious, social, national, and state life based on Islamic values. PLO-2 Students are able to develop a responsible attitude, spirit of independence, and entrepreneurship according to their field of expertise. PLO-4 Students are able to develop networks and work together in teams based on scientific ethics to produce scientific ideas based on science and technology. PLO-8 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO-161 Students are able to prepare a street vendor proposal that includes an introduction (description of the street vendor agency, the purpose of the street vendor, implementation time, implementation method and benefits). CO-162 Students understand general policies related to street vendors, street vendor rules, professional insights, implementation of theories in the professional world, program preparation strategies and street vendor reporting CO-163 Students are able to analyze physics processes in Industry or Research Institutions/Institutes. CO-164 students are able to disseminate the results of fieldwork practice in oral and written communication in the PKL exam
Content	PKL's work program includes areas under the Tridharma of Higher Education, namely the academic field which emphasizes professional development, the research field which emphasizes academic research and the community service field which emphasizes the application of advances in science and technology as well as fostering socio-religious life. The stages of PKL activities: 1. Debriefing 2. Implementation in the Field 3. Report Writing 4. PKL Evaluation Guidelines 5. Rules for PKL Participants
Examination forms	Oral Presentation Test
Study and examination requirements	- Final exams
Reading list	Tim Penyusun. 2014. Pedoman PKL. Praktek Kerja Lapangan Integratif. Fakultas Sains dan Teknologi. UIN Maulana Malik Ibrahim Malang

FUNDAMENTAL OF MATHEMATICS I (22060411C02)

Module designation	Fundamental of Mathematics I
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Wiwis Sasmitaninghidayah, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 3 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 3 x 50 = 100 minutes per week. 2. Exercises and Assignments : 3 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 3 x 60 = 120 minutes (2 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-3 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-5 Students will get an understanding of the theory behind both modern and classical physics, as well as mathematical techniques, technology knowledge, and its application to relevant problems.

CO	CO-171 Students are able to qualitatively and quantitatively analyze the basics of mathematical operations. CO-172 Students are able to apply limit equations to mathematical problems. CO-173 Students are able to understand derivatives qualitatively and quantitatively. CO-174 Students are able to apply derivative applications in solving mathematical problems.
Content	1. Preparation: Real numbers, Estimation, Logic, Inequalities and absolute values, quadratic equations; Rectangular coordinate system; equation graphs; functions and graphs; operations on functions; trigonometric functions. 2. Limits; introduction of limits; in-depth study of limits; limit theorem; limits involve trigonometric functions; limit at infinity, finite limit, continuity of function. 3. Derivatives: Two problems with one theme, derivatives, derivative search rules, derivatives of trigonometric functions, chain rules, Higher order derivatives, Implicit derivatives, Related rates, Differentiation and Approximation; 4. Derivative Applications: Maximum and minimum, monotonicity and concavity, local extremes and extremes on open intervals, practical problems, graphing mathematical functions in calculus; Mean Value Theorem and derivatives, solving equations numerically.
Examination forms	Paper Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Purcell, Kalkulus dan Geometri Analisis, Leithold, The Calculus and analysis Geometry. Salas, Hille. Additional : 1. Eddy Supramono, dkk, 2000, Matematika Dasar, Universitas Negeri Malang– JICA Project. 2. Taufik Raman R., 2004. Matematika Dasar edisi revisi, Bandung: IMSTEP JICA.

BIOLOGY (22060411E01)

Module designation	Biology
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Mujahidin Ahmad, M.Sc.
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-3 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-5 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems..
CO	CO-181 Students are able to analyze logical and systematic thinking from general biological concepts, intracellular communication and homeostasis. CO-182 Students are able to understand energy transformation and impulse induction by nerves. CO-183 Students are able to understand the Heart Work System, Muscle Biophysics and Virus Replication.

	CO-184 Students are able to analyze knowledge about Physics and Environmental Conservation, Environmental Change Phenomena in developing knowledge and technology.
Content	1. Cell Structure 2. Basic Intracellular Communication Mechanisms 3. Extracellular Communication 4. Homeostasis 5. Energy Transformation 6. Impulse Induction by Nerves 7. Heart Work 8. Muscle Biophysics 9. Virus Replication 10. Introduction to Environmental Physics 11. Physics and Environmental Conservation 12. Environmental Change Phenomenon (1)--Depletion of the Ozone Layer 13. Environmental Change Phenomenon (2)--Climate Change
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Campbell, N.A., Reece J.B., and L.G Mitchell. 2016. Intisari Biologi Edisi Keenam. Editor: A. Safitri dkk. Penerbit Erlangga. Jakarta. 2. Campbell, N.A., Reece J.B., and L.G Mitchell. 1999. Biologi Edisi Kelima. Editor: A. Safitri dkk. Penerbit Erlangga. Jakarta. 3. Kimbal, J.W. 1987. Biologi.ed.5. diterjemahkan oleh Soetarmi. Penerbit Erlangga. Jakarta. 4. Soemartowo, Idjah, dkk. 1990. Biologi Umum. Jilid 1, 2,3. Yayasan Studi Kurikulum Biologi. Gramedia. Jakarta. Additional : 1. Sumber lain yang relevan baik dari internet dan

	media lainnya (jurnal atau artikel ilmiah).

FUNDAMENTAL OF CHEMISTRY (22060411E02)

Module designation	Fundamental of Chemistry
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Vina Nurul Istighfarini, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-3 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-5 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.
CO	CO-191 Students are able to analyze logical and systematic thinking from chemistry and its development in science and technology. CO-192 Students are able to understand theoretical concepts about atomic and molecular structures, stoichiometry and chemical reactions. CO-193 Students are able to analyze logical and systematic thinking

	from chemical bonds, physical properties of solutions and their development in science and technology. CO-194 Students are able to understand theoretical concepts and mathematical methods from kinetics, equilibrium and chemical thermodynamics.
Content	1. Basic concepts of chemistry 2. Atoms, molecules and ions 3. Stoichiometry 4. Reactions in solution 5. Gases 6. Energy relationships in chemical reactions 7. Electronic structure of the atom 8. Chemical bond 9. Physical properties of solutions 10. Chemical kinetics 11. Chemical equilibrium 12. Chemical thermodynamics 13. Redox and Electrochemical Reactions 14. Core chemistry
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Chang, Raymond and Overby, Jason. 2011. General Chemistry: The Essential Concepts, 6th Edition. McGraw-Hill, New York. Additional : 1. Brady, James E. Kimia Universitas Asas & Struktur, Jilid 2. Binarupa Aksara. 2. S. Sukri, 1999, Kimia Dasar 2, Penerbit ITB. 3. Kotz and Purcell, 1991, Chemistry & Chemical Reactivity, Saunders College Publishing. 4. Keenan, Keinfelter and wood, 1984, Kimia Untuk

	Universitas, jilid 2, PT. Gelora Aksara Pratama.

FUNDAMENTAL OF MATHEMATICS II (22060411E03)

Module designation	Fundamental of Mathematics II
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Wiwis Sasmitaninghidayah, M.Si.
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 3 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 3 x 50 = 100 minutes per week. 2. Exercises and Assignments : 3 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 3 x 60 = 120 minutes (2 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course prerequisite: Fundamental of Mathematics I (22060411C02)
Module objectives/intended learning outcomes	PLO-3 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-5 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.
CO	CO-201 Students are able to analyze systematic thinking in knowledge of integrals and definite integrals. CO-202 Students are able to understand transcendental functions in relevant problems. CO-203 Students are able to apply exponential functions in mathematical problems.

	CO-204 Students are able to analyze logical and systematic thinking in integration theory qualitatively and quantitatively.
Content	Indefinite Integrals & Generalized power rules, and Introduction to Differential equations; Definite Integrals: Introduction to area and definite integrals, First basic theorem of calculus, Second basic theorem of calculus and substitution method; Transcendent Functions: Natural logarithmic functions, inverse functions and their derivatives, Natural exponential functions, general exponential and logarithmic functions, Trigonometric inverse functions and their derivatives, Hyperbolic functions and their inverses, Integration Techniques: Basic Integration Rules and Partial Integrals, Trigonometric Integrals and rationalized Substitutions, Integration of rational functions using partial fractions, strategies for integration; Indefinite forms and improper integrals: Indefinite forms of type 0/0, Other types of indefinite forms, Limits of integration and infinite integrals
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. D. Valberg, E. Purcell, S. Rigdon. Calculus, 9th Edition. Pearson. 2006 2. Sasmitaninghidayah, W., ”Belajar Mandiri Integral ”. Litnus. 2023 Additional : 1. D. Mursita. Matematika Dasar untuk Perguruan Tinggi. Rekayasa Sains. 2006.J. 2. Stewart. Calculus, 7th Edition. Brooks Cole. 2012.

FUNDAMENTAL OF PHYSICS I (22060411E04)

Module designation	Fundamental of Physics I
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Abdul Basid, M.Si.
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative Learning, Project Based Learning 2 x 50” x 16 week per Semester Practicum: 1x170” x 10 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week. 4. Practicum : 1 x 170 = 170 minutes per week
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -

Module objectives/intended learning outcomes	PLO-3 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-4 Able to develop networks and work together in teams based on scientific ethics to produce scientific ideas based on science and technology. PLO-5 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-7 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science.
CO	CO-211 Students are able to analyze logical and systematic thinking in the concept of physical properties and structures, quantities and units, measurement, uncertainty, vector concepts, motion, Force, Work and Energy.. CO-212 Students are able to understand the concept of momentum and collision, rotational motion, rigid body equilibrium in various physical situations. CO-213 Students are able to apply theoretical concepts of fluid mechanics, vibrations, waves, sound, and elasticity in physical phenomena. CO-214 Students are able to apply the concepts of temperature, heat, laws of thermodynamics, phenomena of energy change, heat transfer, and basic principles of thermodynamics in various physical systems.
Content	1. Physical Properties and Structure, Quantities and Units, Measurement, Uncertainty and Vectors 2. Motion in one and two dimensions, dynamics, work and energy 3. Linear Momentum and Collisions,

	4. Rotational Motion 5. Equilibrium of Rigid Bodies 6. Fluid Mechanics 7. Vibrations and Waves, Sound and Elasticity 8. Temperature and Heat 9. Laws of Thermodynamics
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main: 1. Douglas C. Giancoli, FISIKA 1, Erlangga-Jakarta. 2. David Halliday & Robert Resnick, FISIKA 1, Erlangga-Jakarta. 3. Paul A. Tipler, FISIKA 1, Untuk Sains dan Teknik, Erlangga-Jakarta.

FUNDAMENTAL OF PHYSICS II (22060411E05)

Module designation	Fundamental of Physics II
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Abdul Basid, M.Si.
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative Learning, Project Based Learning 2 x 50" x 16 week per Semester Practicum: 1x170" x 10 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week. 4. Practicum : 1 x 170 = 170 minutes per week
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: Fundamental of Physics I (22060411E04)

Module objectives/intended learning outcomes	PLO-3 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-4 Able to develop networks and work together in teams based on scientific ethics to produce scientific ideas based on science and technology PLO-5 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-7 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science
CO	CO-221 Students are able to understand the concept of Coulomb's law, electric fields, and electric potential. CO-222 Students are able to analyze logical thinking in the concept of capacitors, capacitor circuits, Ohm's law, the conductivity properties of materials in electrical circuits, as well as Kirchoff's laws I and II, Chemical EMF, and electrolysis. CO-223 Students are able to analyze the concept of Lorentz force, magnetic induction, as well as Ampere's, Faraday's, and Lentz's laws. CO-224 Students are able to apply mathematical models in the concept of AC circuits and series RLC circuits in alternating current.

Content	1. Coulomb's Law 2. Electric field 3. Electrical potential 4. Capacitor 5. Capacitor Network 6. Ohm's law, the conductivity properties of electrical circuit materials 7. Kirchoff's Laws I and II, GGL Chemistry and Electrolysis 8. Lorentz Style 9. Magnetic Induction 10. Ampere's Law, Faraday's Law, Lentz 11. AC Network 12. Series RLC circuit at Reciprocating current
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main: 1. Douglas C. Giancoli, FISIKA 2, Erlangga-Jakarta. Additional: 1. David Halliday & Robert Resnick, FISIKA 2, Erlangga-Jakarta. 2. Paul A. Tipler, FISIKA 2, Untuk Sains dan Teknik, Erlangga-Jakarta.

FLUID PHYSICS (22060411E06)

Module designation	Fluid Physics
Semester(s) in which the module is taught	3th Semester
Person responsible for the module	Dr. Erna Hastuti, M.Si Wiwis Sasmitaninghidayah, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: Fundamental of Physics II (22060411E05)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science.

CO	CO-231 Students are able to analyze logical and systematic thinking in the scope of fluids and fluid properties. CO-232 Students are able to analyze fluid statics problems. CO-233 Students are able to apply physics concepts in the balance of floating objects and fluid kinematics. CO-234 Students are able to apply the law of conservation of energy and Bernoulli's equation in physics problems.
Content	1. Introduction; definition and scope of units, 2. Properties of gas and liquid fluids, 3. Fluid statics 4. Equilibrium of floating bodies 5. Fluid kinematics 6. Law of conservation of energy and Bernoulli equation
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Young, H.D. and Freedman, R.A., 2015. University physics with modern physics. Pearson Higher Ed. Additional: 1. Halliday & Resnick, S.C., 2011, “Fundamentals of Physics”, 9th ed., John Wiley & Sons, Inc. 2. Serway & Jewett, “Physics for Scientists and Engineering”, 6th ed. Thomson Brooks/Cole.

EARTH SCIENCE (22060411E07)

Module designation	EARTH SCIENCE
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Drs. Abdul Basid, M.Si.
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-3 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-5 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-7 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science.

CO	CO-241 Students are able to apply logical thinking in geology, materials and energy, structures, minerals, rock formation processes, volcanic mechanisms and weathering processes and land movement. CO-242 Students are able to analyze geological time, gravity and magnetization, rivers, coastal zones and oceans, tectonic plates and earth resources and planetary geology.
Content	1. Geology 2. Matter and energy 3. Structure, composition and identification of minerals 4. The process of rock formation 5. Volcano mechanisms and mountain formation 6. Weathering processes and soil movement 7. Geological time 8. Gravity and magnetism 9. Rivers, coastal zones and oceans 10. Dry areas, wind activity, glisters, glaciation and climate change 11. Plate tectonics and rock deformation 12. Earth resources and Planetary geology
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main: 1. Ludman Allan,Nicholas K Coch.1982.physical geologi.United states of America: McGraw-Hill Book Company. Additional: 1. Burger, Henry Robert. 1992. Exploration Geophysics of the Shallow Subsurface. New Jersey: Prentice Hall. 2. Lowrie, William. 2007. Fundamental of Geophysics Second Edition. New York: Cambridge University Press. 3. Tjasyono,Bayong. 2013. Ilmu Kebumian dan Antariksa. Bandung: PT Remaja Rosdakarya. 4. Philpotts, A.R. 2003. Petrography of Igneous and Metamorphic Rocks. Waveland Press, Inc., Illinois.

ASTRONOMY (22060411E08)

Module designation	Astronomy
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Rusli, M.Si.
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-3 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-5 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-6 Able to correlate Islamic knowledge, integration of Islam, and science as a scientific paradigm. PLO-7 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science.

CO	CO-251 Students are able to formulate the Gregorian and Hijri calendars. CO-252 Students are able to analyze alternative solutions in the Global Hijri calendar, direction of the Qibla, prayer times, and phases of the moon. CO-253 Students are able to correlate digital image processing and digital signals for Fajar and Syafaq data
Content	1. Falak science and its novelty 2. Gregorian calendar 3. Hijri calendar 4. Global Hijriyah Calendar 5. Qibla Direction 6. Prayer Times 7. Phases of the Moon 8. Digital Image Processing for Fajar Data 9. Digital Image Processing for Syafaq Data 10. Digital Signal Processing for Dawn Data 11. Digital Signal Processing for Syafaq Data
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Basori, Muhammad Hadi, 2015. Pengantar Ilmu Falak. Jakarta, Pustaka Al-Kautsar. Additional: 1. Butar-Butar, Arwin Juli Rakhmadi, 2018. Fajar dan Syafak dalam Kesarjanaan Astronom Muslim dan Ulama Nusantara. Yogyakarta, LKIS. 2. Meeus, Jean, 1991. Astronomical Algorithms. Virginia, Wilman-Bell, Inc. 3. Blanchet, Gerard dan Maurice Charbit. 2001. Digital Signal and Image Processing using Matlab.

	London, ISTE. 4. Rusli dan Abdul Basid, 2020. Menyibak Lailatul Qadar Tinjauan Geosains dan Astronomi. Malang, UIN MALIKI Press. 5. Rusli dkk,. 2021 Image Processing to Know the Down of Shadiq Using Matlab Software. Atlantis Press.

STATISTICS (22060411E09)

Module designation	Statistics
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Agus Mulyono, M.Kes
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-3 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-5 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-7 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science

CO	CO-261 Students are able to apply basic statistical concepts, including the definition of statistics, objectives, functions, and roles of statistics, as well as the scope of statistics. CO-262 Students are able to analyze data collection and presentation techniques in the form of tables and diagrams. CO-263 Students are able to analyze the concept of measures of central tendency, dispersion, deviation, measures of slope, measures of sharpness, and sampling techniques. CO-264 Students are able to analyze alternative solutions to data analysis requirements testing techniques and correlational and comparative hypothesis tests.
Content	1. The nature of statistics 2. Understanding statistics 3. Objectives of statistics 4. Functions and roles of statistics 5. Scope of Statistics) 6. Data collection and presentation 7. Data collection 8. Presentation of data in tabular form, 9. Presentation of data in diagram form 10. Descriptive data processing 11. Measure of central tendency 12. Dispersion 13. Deviation 14. Slope Measure 15. Tapered Size 16. Sampling 17. Inferential data processing 18. Test data analysis requirements 19. Test correlational and comparative hypotheses
Examination forms	Paper Based Test

Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Sudjana. (2001). Metode Statistika. Bandung: Tarsito. (2009). Metode Penelitian Kuantitatif Kualitatif dan R&D. Bandung: Alfabeta Additional: 1. Agus Widarjono. (2015). Analisis Statistik Multivariat Terapan. Sleman: UPP STIM YKPN. 2. Allan G Bluman. (2012). Elementary Statistics. A Step by Step Approach. Eighth Edition. New York: McGraw-Hill Companies, Inc. 3. Habiby, Wahdan Najib. (2017). Statistik Pendidikan. Surakarta: Muhammadiyah University Press. 4. Ian S.Peers. (1996). Statistical Analysis for Education and Psychology Researchers. United Kingdom: Falmer Press. 5. Jack R. Fraenkel and Norman E. Wallen. (1993). How to Design and Evaluate Research in Education. NewYork: McGraw-Hill Inc. 6. Michel H. Kutner. (2005). Applied Linear Statistical Models. Fifth Edition. New York: MCGraw-Hill. 7. Riduwan, (2009). Skala Pengukuran Variabel-Variabel Penelitian. Bandung: CV Alfabeta. 8. Riduwan dan Sunarto. (2009). Pengantar Statistika untuk Penelitian Pendidikan, Sosial, Ekonomi, Komunikasi dan Bisnis. Bandung: CV Alfabeta. 9. Roger K. Kirk. (2008). Statistics in Introduction. Fifth Edition. Belmont: Thomson Wadsworth. 10. Ronny Kountour. (2005). Statistik Praktis. Pengolahan Data untuk Skripsi dan Tesis. Jakarta, PPM. 11. Sujianto, A.E. (2009). Aplikasi Statistik dengan

	SPSS 16.0. Tulungagung: Prestasi Pustaka.

INSTRUMENTATION AND MEASUREMENT (22060411E10)

Module designation	Instrumentation and Measurement
Semester(s) in which the module is taught	4th Semester
Person responsible for the module	Dr. Imam Tazi
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	● Lectures : 2 x 50 = 100 minutes per week. ● Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. ● Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the number of lectures to be able to take the exam Course prerequisites: -
Module objectives/intended learning outcomes	PLO-3 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-5 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-7 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science

CO	CO-271 Students are able to understand Significant Figures and Quantities and measurements in the field of physics. CO -272 Students are able to apply theories about measurement errors, Basics of measuring instruments and Measurement techniques in the field of physics. CO -273 Students are able to apply theories about measuring instruments and uncertainty in measuring physical quantities. CO -274 Students are able to analyze the distribution of measurement data and data rejection in physical measurements.
Content	1. Significant figures 2. Quantities and measurements 3. Measurement errors 4. Fundamentals of measuring instruments 5. Measurement techniques 6. Oscilloscope 7. Simple measuring instruments 8. Muscle fatigue measurement instruments 9. Measurement uncertainty 10. Conventional and electrical measurements 11. Normal distribution 12. Data rejection
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. Cooper, William D.1985. Electronic Instrumentation and Measurement Techniques. Prentice Hall. USA 2. Jon S. Wilson . 2005. Sensor Technology HandbooEditor-in-Chief, Copyright © 2005, Elsevier Inc.USA 3. Hans-Petter Halvorsen, M.Sc, Sensors and Actuators with Arduino

RENEWABLE ENERGY (22060411E11)

Module designation	Renewable Energy
Semester(s) in which the module is taught	4^{th} Semester
Person responsible for the module	Cecep E. Rustana, Ph.D.
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	• Lectures : 2 x 50 = 100 minutes per week. • Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. • Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the number of lectures to be able to take the exam Course Prerequisites: -
Module objectives/intended learning outcomes	PLO-1 Able to adapt academic norms and ethics in the implementation of science and technology in religious social, national, and state life based on Islamic values. PLO-3 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-5 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-7 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science

CO	CO-281 Students are able to understand the principles of renewable energy. CO -282 Students are able to analyze renewable energy sources. CO -283 Students are able to analyze storage and distribution systems for various types of energy. CO -284 Students are able to analyze alternative solutions by considering environmental, economic and other factors related to the use of renewable energy.
Content	1. Conventional energy, renewable energy, types of energy, and energy utilization 2. Issues in the field of energy 3. Solar thermal energy and solar cells 4. Photovoltaic solar energy 5. Wind energy 6. Hydropower: hydroelectricity and micro-hydro 7. Tidal and ocean wave energy 8. Biomass energy 9. Biogas energy 10. Biofuel/bioethanol energy 11. Geothermal energy 12. Nuclear energy 13. Energy policies
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Kementerian Riset dan Teknologi, “Buku Putih Energi Indonesia 2005-2025”, Jakarta, 2006. 2. Penick T and Louk B., “Photovoltaic Power Generation. Gale Greenleaf”,1998. 3. Djiteng Marsudi, “Pembangkitan Energi Listrik”, Penerbit Erlangga, 2005. 4. Marek Walisewicz, ”Energi Alternatif”, Penerbit Erlangga, 2002. 5. Arismunandar, W. ”Penggerak Mula : Motor Bakar Torak”, ITB Bandung. 2005. 6. Ganesan, V. “Internal Combustion Engines”, Second Edition. New Delhi, The MC Graw Hill, 2006. 7. Victor L Streeter, E.B.W. ”Mekanika Fluida”, Jakarta,Erlangga, 1995. 8. Daryanto, ”Teknik Konversi Energy” Satu Nusa. Bandung, 2010. 9. Fritz DietZel, Dakso Sriyono, ”Turbin, Pompa Dan Kompresor”, Gelora Aksara Pratama, 2008. 10. ”Menggali Potensi Energi Terbarukan dari Laut”, Maritim Indonesia, Edisi 26/Th VII/April-Juni/2012. Jakarta, 2012.

ALGORITHM AND PROGRAMMING (22060411E12)

Module designation	Algorithm and Programming
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Mokhamad Tirono
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	• Lectures : 2 x 50 = 100 minutes per week. • Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. • Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the number of lectures to be able to take the exam Course prerequisites: -
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science

CO	CO-291 Students are able to understand the basic algorithms. CO-292 Students are able to apply knowledge of numerical algorithms, linked lists and arrays in physics problems. CO-293 Students are able to analyze physics problems based on stacks and queues, sorting, and searching. CO-294 Students are able to analyze physics phenomena that match the hypothesis in the searching method and Randomized algorithm. CO-295 Students are able to compile physical modeling by utilizing Hash Tables and Hash, Binary Trees and Priority Queues and Heapsort.
Content	Fundamentals of Algorithms: Algorithmic Approach and Data Structure, Algorithm Features, Pseudocode Notation; Numerical Algorithms: Data Shuffling, Finding the Greatest Common Divisor, Exponential Computation, Working with Prime Numbers, Numerical Integration, Finding Zeros; Linked Lists: Basic Concepts, Single Linked List, Doubly Linked List, Sorted Linked List, Linked-List Algorithms; Arrays: Basic Concepts, One-Dimensional Arrays, Non-Zero Lower Bounds, Triangular Arrays, Sparse Arrays, Matrices; Stacks and Queues: Stacks, Queues; Sorting: O(N2) Algorithms, O(N log N) Algorithms, Sub O(N log N) Algorithms; Searching: Linear Search, Binary Search, Interpolation Search; Randomized Algorithms: Random Number Generation, Results of Applying Tests, Other Random Number Distributions; Hashing and Hash Tables: Hash Functions, Collision Resolution with Linear Probing, Other Open-Addressing Schemes, Collision Resolution through Chaining, Collision Resolution through Bucketing, Hash Tables on Disk; Binary Trees: Creating a Binary Tree, Insertion and Deletion with a Binary Tree, Navigating through a Binary Tree; Priority Queues and Heapsort: The Priority Queue, The Heap, Heapsort, Extending the Priority Queue.
Examination forms	Paper Based Test

Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. Bucknall J. 2001, The Tomes of Delphi Algorithms and Data Structures, Wordware Publishing, Inc 2. Stephens R., 2013, Essential Algorithms A Practical Approach to Computer Algorithms, Willey 3. Karumanchi N., 2016, Data Structures And Algorithmic hinking With Python, CareetMonk Publications 4. Hjorth-Jensen M., 2013, Computational Physics, University of Oslo

MATHEMATICAL PHYSICS I (22060411E13)

Module designation	Mathematical Physics I
Semester(s) in which the module is taught	3^{th} Semester
Person responsible for the module	Naqiibatin Nadliriyah, M.Si.
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 3 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	● Lectures: 3 x 50 = 150 minutes per week. ● Exercises and Assignments: 3 x 60 = 180 minutes (3 hours) per week. ● Private learning: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the number of lectures to be able to take the exam Course Prerequisites: Fundamental of Mathematics II (22060411E03)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values. PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science

CO	CO301 Students are able to apply theoretical concepts of Matrix, Vector, and Linear Equations and their application in relevant problems. CO302 Students are able to apply theoretical concepts of Partial Differentials and their application in relevant problems. CO303 Students are able to apply Fold Integrals and their application in relevant problems. CO304 Students are able to analyze theoretical concepts of Vector Analysis and their application in relevant problems.
Content	1. Linear Algebra: a. Matrices, b. Vectors, c. Linear Equations, 2. Partial Differential Equations, 3. Multiple Integrals, 4. Vector Analysis.
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. M. L. Boas,"Mathematical Methods in The Physical Sciences. Third Edition" John Wiley & Sons, Canada, 2006 *2.* G. B. Arfken, H. J. Weber and F. E. Harris, "Mathematical Methods for Physicists. A Comprehensive Guide, Seventh Edition" Academic Press, Oxford, 2013

MATHEMATICAL PHYSICS II (22060411E14)

Module designation	Mathematical Physics II
Semester(s) in which the module is taught	4^{th} Semester
Person responsible for the module	Naqiibatin Nadliriyah, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 3 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	● Lectures : 3 x 50 = 150 minutes per week. ● Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. ● Private learning : 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Mathematical Physics I (22060411E13)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-311 Students are able to logically and systematically analyze thinking in the concepts of Algebra, Complex Numbers, and Complex Functions. CO-312 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology related to Ordinary Differential Equations. CO-311 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology related to Coordinate Transformation. CO-314 Students are able to apply physical problems and mathematical models in physics related to Special Functions.
Content	Complex numbers 1. Complex Algebra 2. omplex Functions GDP: 1. 1st order GDP 2. Higher order GDP 3. Laplace transform Coordinate Transformation 1. Linear Transformation 2. Orthogonal Transformation Special Functions 1. Factorials 2. Gamma 3. Beta
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. M. L. Boas,”Mathematical Methods in The Physical Sciences. Third Edition” John Wiley & Sons, Canada, 2006 2. G. B. Arfken, H. J. Weber and F. E. Harris, “Mathematical Methods for Physicists. A Comprehensive Guide, Seventh Edition” Academic Press, Oxford, 2013

MATHEMATICAL PHYSICS III (22060411E15)

Module designation	Mathematical Physics III
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Naqiibatin Nadliriyah, M.Si *Please indicate a specific person.*
Language	Indonesian
Relation to curriculum	Compulsory Courses for Undergraduate Program in Bachelor of Physics
Teaching methods	Problem-Based Learning 3 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 3. Private learning : 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Mathematical Physics II (22060411E14)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-321 Students are able to apply physical problems and mathematical models in physics related to Special Functions. CO-322 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in Fourier series and Fourier Transformations. CO-323 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology related to series methods in solving differential equation problems. CO-323 Students are able to apply physical problems and mathematical models in physics in the field of Calculus of Variations.
Content	Row 1. Convergent and divergent series 2. Test Convergence of series 3. Alternating series 4. Power series 5. Function expansion using power series Fourier Series and Transformation 1. Periodic function 2. Average value of a continuous function 3. Fourier coefficients 4. Dirichlet Conditions 5. Complex form Fourier series 6. Even and odd functions 7. Parseval's Theorem 8. Fourier Transform Series solutions for Differential Equations 1. Series method 2. Legendre Polynomials 3. Generator Function Calculus of Variations 1. Euler's Equation *2.* Lagrange's equation

Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. M. L. Boas,"Mathematical Methods in The Physical Sciences. Third Edition" John Wiley & Sons, Canada, 2006 2. G. B. Arfken, H. J. Weber and F. E. Harris, "Mathematical Methods for Physicists. A Comprehensive Guide, Seventh Edition" Academic Press, Oxford, 2013

ELECTRONICS I (22060411E16)

Module designation	Electronics I
Semester(s) in which the module is taught	3rd Semester
Person responsible for the module	Farid Samsu Hananto, M.T
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning, Project Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. *3.* Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Fundamental Physics II
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-04 Students are able to compile scientific descriptions, develop networks, and work in a team to study the implications of the development or implementation of science and technology. PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-331 Students are able to logically and systematically analyze thinking in the basic laws of circuits, both in AC and DC circuits. CO-332 Students are able to analyze knowledge of technology in relevant problems related to the basic laws of circuits in AC and DC currents. CO-333 Students are able to analyze knowledge of technology in relevant problems related to the function and operation of Active and Passive Components in Electronics. CO-334 Students are able to apply physical problems and mathematical models about the characteristics of active and passive components in electronics.
Content	1. Electric Current and Voltage 2. Direct Current Circuit 3. Circuit laws 4. Electrical measuring instruments 5. Capacitors and Inductors in AC Circuits 6. Fashor's theory 7. Semiconductors 8. Diode and Rectifier Circuit 9. Bipolar Transistors *10.* Field Effect Transistor
Examination forms	Paper-based Test, Project Report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Onno W. Purbo, 2000, Buku Ajar Elektronika Dasar 1. Fakultas Teknik Elektro ITB Sutrisno, Elektronika dan Penerapannya Jilid 1, 1986, Penerbit ITB Mohamad Ramdhani, ST. 2005. Rangkaian Listrik. STT Telkom. Bandung John Bird, Electrical and Electronic Principle and Technology, Newnes Owen Bishop, Electronics, A First Course, Newnes

ELECTRONICS II (22060411E17)

Module designation	Electronics II
Semester(s) in which the module is taught	3^{rd} Semester
Person responsible for the module	Farid Samsu Hananto, M.T .
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning, Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Electronics I (22060411E16)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-04 Able to develop networks and work together in teams based on scientific ethics to produce scientific ideas based on science and technology. [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]
CO	CO-341 Students are able to develop innovative and independent thinking related to theoretical concepts about amplifiers using transistors.

	CO-342 Students are able to develop teamwork spirit based on scientific ethics related to the theory of small signal amplifiers in electronic circuits. CO-343 Students are able to analyze knowledge of technology in relevant problems related to amplifiers. CO-344 Students are able to apply physical problems and mathematical models in physics related to the concept of Operational amplifiers and oscillators and their applications in electronic circuits.
Content	1. Amplifiers 2. Amplifier with Transistor 3. Biasing in the amplifier circuit 4. Characteristics of Amplifiers with Tansistor 5. Power Amplifiers 6. Feedback on Applifier 7. Operational Amplifier 8. Inverting and Non-Inverting Amplifier Circuits with OP-AMP 9. Arithmetic Circuits (adder, subtractor, multiplier) with OP-Amp 10. Integrator and differentiator circuit with Op-Amp 11. Oscillator Circuit 12. IC 555
Examination forms	Paper Based Test, Project Report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Onno W. Purbo, 2000, Buku Ajar Elektronika Dasar 1. Fakultas Teknik Elektro ITB Sutrisno, Elektronika dan Penerapannya Jilid 1, 1986, Penerbit ITB Mohamad Ramdhani, ST. 2005. Rangkaian Listrik. STT Telkom. Bandung John Bird, Electrical and Electronic Principle and Technology, Newnes Owen Bishop, Electronics, A First Course, Newnes

CLASSICAL MECHANICS (22060411E18)

Module designation	Classical Mechanics
Semester(s) in which the module is taught	3rd Semester
Person responsible for the module	Muthmainnah, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 3 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 3. Private learning : 3 x 60 = 120 minutes (3 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Fundamental of Physics II (22060411E05)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-351 Students are able to logically and systematically analyze thinking in the coordinate system for solving classical mechanics problems. CO-352 Students are able to logically and systematically analyze thinking in the motion of particles in one, two, and three dimensions by understanding time functions, velocity, and position. CO-353 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology related to the concepts and applications of harmonic motion, Kepler's law, and Newton's gravity. CO-354 Students are able to apply physical problems and mathematical models in physics related to concepts in Lagrangian Mechanics and Hamiltonian Mechanics.

Content	1. Vector; Integral; Differential 2. Coordinate systems:Cartesian, Polar, Cylindrical, Spherical 3. 1-dimensional particle movement with force as a function of time, speed function and position function. 4. Two-dimensional particle motion, three-dimensional particle motion 5. Particle dynamics: concepts and basic laws of dynamics, application of Newton's laws, friction force, dynamics of uniform circular motion 6. System of two mass particles, System of N particles, Linear momentum, Conservation of linear momentum, System with changing mass 7. Harmonic motion, Application of simple harmonic motion, Coupled oscillations 8. Kepler's law and Newton's gravity, Motion of planets and satellites, Gravitational potential energy 9. Rotational dynamics of particles and rigid bodies, rotational motion, torque, particle angular momentum, rotational kinetic energy and rotational inertia 10. Lagrange mechanics 11. Hamiltonian Mechanics
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Gonjang Prajitno dan Didiek Basuki R. 2000. Buku Ajar Mekanika 1. Jurusan Fisika Fakultas matematika dan Ilmi Pengetahuan Alam Institut Teknologi Sepuluh Nopember Surabaya. -Masruroh, Gonang Soraja, Setyawan P Sakti, Makanika 1, 2017, ISBN 602432085X, 9786024320850. UB Press. Malang

MODERN PHYSICS (22060411E19)

Module designation	Modern physics
Semester(s) in which the module is taught	3th Semester
Person responsible for the module	-
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning, Inquiry Based Learning 3 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 3. Private learning : 3 x 60 = 120 minutes (3 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Fundamental Physics II (22060411E05)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-361 Students are able to logically and systematically analyze thinking in Modern Physics knowledge, especially the principles of special and general relativity, and the quantum nature of light. CO-362 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and technology knowledge related to atomic structure, the wave nature of particles, and the particle nature of waves. CO-363 Students are able to apply physical problems and mathematical models in physics related to the uncertainty principle, wave functions, and wave equations.
Content	1. Principles of Special and General Relativity 2. Quantum properties of light 3. Understand atomic structure 4. Wave properties of particles 5. Particle Properties of Waves 6. Principle of Uncertainty 7. Wave functions and equations
Examination forms	Paper Based Test, Project Report, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Beiser, A., *Konsep Fisika Modern* (terjemahan The Houw Liong), Erlangga, Jakarta, 2014 Krane, K., *Modern Physics*, John Wiley, 2012. Atam P. Arya, *Elementary Modern Physics*, Addison Wesley, 2011. Eisberg R., and Resnick R.,*Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles*, John Wiley, 1974. S. P. Thornton dan A. Rex, Modern Physics 3rd ed., Thomson Brooks/Cole, 2006. R. Harris, Modern Physics 2nd ed., Pearson, 2008. J. Bernstein, P. M. Fishbane, and S. Gasiorowicz, Modern Physics, Prentice Hall, 2000 Serway, Moses dan Moyer. (1997). Modern Physics. San Diego: saunders College Publishing Referensi Rohlf,William J .(1994). Modern Physics from α to Z_0. New york: John Wiley & Sons.In

ALTERNATING CURRENT (22060411E20)

Module designation	Alternating Current
Semester(s) in which the module is taught	3rd Semester
Person responsible for the module	Muthmainnah, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning, Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-371 Students are able to logically and systematically analyze thinking in basic circuit concepts, electrical elements, and basic circuit laws. CO-372 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology related to complex numbers and impedance, alternating waveforms, sinusoidal voltage and current in electrical circuits. CO-373 Students are able to apply various circuit analysis methods in alternating current circuits. CO-374 Students are able to apply physical problems and mathematical models in physics related to complex frequency, transfer functions, and can analyze magnetic coupling circuits.
Content	1. Basic concepts of electrical circuits 2. Elements of electrical circuits 3. Circuit laws 4. Complex numbers 5. Complex impedance 6. Alternating waveform 7. Sinusoidal voltage and current 8. Network analysis methods 9. Complex frequency and transfer function 10. Magnetic clutch circuit
Examination forms	Paper Based Test, Project Report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Arsan, ST. MT. 2014. Buku Ajar Rangkaian Listrik 1. Fakultas Teknik. Universitas Malikussaleh Mohamad Ramdhani, ST. 2005. Buku Ajar Rangkaian Listrik. STT Telkom. Bandung Cekmas Cekdin dan Taufik Barlian. 2013. Rangkaian Listrik. Yogyakarta: Penerbit Andi

WAVES (22060411E21)

Module designation	Waves
Semester(s) in which the module is taught	4th Semester
Person responsible for the module	Dr. Mokhammad Tirono, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning, Project Based Learning 3 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 3. Private learning : 3 x 60 = 120 minutes (3 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Mathematical Physics I (22060411E13)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science.[KK]

CO	CO-381 Students are able to logically and systematically analyze thinking in Simple Harmonic Motion. CO-382 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and technology knowledge related to damped harmonic oscillators and wave propagation in relevant problems. CO-383 Students are able to analyze knowledge of technology in theoretical concepts, mathematical methods, alternative solutions for standing waves and longitudinal waves. CO-384 Students are able to apply physical problems and mathematical models in digital modulation.
Content	Simple Harmonic Motion: Physical Characteristics of Simple Harmonic Oscillators, Mass in Springs, Pendulums, Oscillations in Electrical Circuits; Damped Harmonic Oscillators: Physical Characteristics of Damped Harmonic Oscillators, Rate of Energy Loss in Damped Harmonic Oscillators, Damped Electrical Oscillations; Wave Propagation: Physical Characteristics of Waves, Wave Propagation, Wave String Equations, Wave Energy, Energy Transport by Waves, Waves at Discontinuities, Two and Three Dimensional Waves; Standing Waves: Standing Waves on Strings, Standing Waves as Superposition of Two Waves, Standing Wave Energy, Standing Waves as Normal Varieties of String Vibrations; Longitudinal Waves: Sound Waves in Gases, Distribution of Sound Wave Energy, Intensity of Sound Waves, Longitudinal Waves in Solids, Sound Waves in the Periodic System, Reflection and Transmission of Sound Waves; Digital Modulation: Baseband (Line Code) Modulation, Frequency Shift Keying, Phase Shift Keying, Minimum Shift Keying and MSK-Type Modulations, Continuous Phase Modulation, Multi-h Continuous Phase Modulation, Quadrature Amplitude Modulation, Nonconstant-Envelope Bandwidth-Efficient Modulations, Performance of Modulations in Fading Channels
Examination forms	Paper-based Test, Project Report

Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. George C. King, 2009, Vibrations and Waves, A John Wiley and Sons, Ltd., Publication 2. H. J. Pain, 2005, The Physics Of Vibrations And Waves, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England 3. Fuqin Xiong, 2006, Digital Modulation Techniques Second Edition, Artech House telecommunications library 4. Marvin K. Simon, 2001, Bandwidth-Efficient Digital Modulation with Application to Deep-Space Communications, Monograph 3 Deep–Space Communications and Navigation Series

DIGITAL ELECTRONICS (22060411E22)

Module designation	Digital Electronics
Semester(s) in which the module is taught	3rd Semester
Person responsible for the module	Muthmainah, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning, Project Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Electronics I (22060411E16)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-391 Students are able to logically and systematically analyze thinking in number systems, number system conversions, and arithmetic operations. CO-392 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology related to the basic principles of logic gates, combinations of logic gates, truth tables, and can use Boolean algebra and Karnaugh maps to design logic circuits. CO-393 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology related to the characteristics of transistor-transistor logic (TTL) and sequential logic circuits. CO-394 Students are able to apply physical problems and mathematical models in physics related to multiplexer, demultiplexer, decoder, and encoder circuits.
Content	1. Number systems and number system conversions 2. Arithmetic of number systems 3. Basic logic gates, combinations and truth tables 4. Boolean algebra 5. Karnough map 6. Transistor-transistor logic (TTL) 7. Sequential logic circuits and digital design 8. Flip flop 9. Multiplexer, demultiplexer 10. Decoders, encoders 11. Counter 12. Register
Examination forms	Paper Based Test, Project Report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Dr. Yulkifli. 2014. Bahan Ajar Elektronika Digital. Jurusan Fisika Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Negeri Padang Owen Bishop, 2011, Electronics Circuits and Systems, Fourth Edition Mike Tooley, 2006, Electronic Circuits Fundamentals and Applications. Third Edition KF Ibrahim, 1996, Teknik digital. Yogyakarta : Andi Thomas L. Floyd, David Buchla. 2007. *Fundamentals of Analog Circuits*. New Jersey: Prentice Hall. Douglas V. Hall, Digital Electronic and Design, Mc Graw Hill, 1990 Malvino, Electronic Digital and Application, Mc Graw Hill, 1990

ELECTRICITY AND MAGNETISM I (22060411E23)

Module designation	Electricity and Magnetism I
Semester(s) in which the module is taught	4^{th} Semester
Person responsible for the module	Ahmad Luthfin, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning, Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Modern Physics (22060411E19)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-401 Students are able to logically and systematically analyze thinking in Coulomb's Law and its vector analysis, electric fields (vector analysis), and the principle of superposition for continuous charge distributions. CO-402 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and technology knowledge related to Gauss's Law in both integral and differential forms and their applications, electric potential, electrostatic field energy, conductors (charge induction, surface charge, and force on conductors, capacitors), Laplace's equation, image methods, and multipole expansion variable separation. CO-403 Students are able to apply physical problems and mathematical models related to electric fields in materials (polarization concept), electric polarization fields, electric displacement fields, and linear dielectrics.
Content	1. Coulomb's law and vector analysis 2. Electric field (vector analysis). 3. Superposition principle for continuous charge distribution 4. Gauss's Law in integral and differential form and its applications. 5. Electric potential, electrostatic field energy. 6. Conductors (induced charge, surface charge and force on conductor materials, capacitors) Laplace's equation. 7. Image method and separation of variables 8. multipole expansion 9. Electric fields in materials (polarization concept) 10. Electric field polarization
Examination forms	Paper Based Test, Project Report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	J. R. Reitz," *Foundations of Electromagnetic Theory*", Addison-Wesley Publ., 1993 D. J. Griffith," *Introduction to Electrodynamics*", Prentice-Hall Inc.,1989. J. D. Jackson," *Classical Electrodynamics*", John Wiley & Sons Inc., 1991 Roaid K Wangsness," *Electromagnetic Fields*", 2^{nd} edition , John Wiley & Sons Inc., 1991

ELECTRICITY AND MAGNETISM II (22060411E24)

Module designation	Electricity and Magnetism II
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Ahmad Luthfin, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning, Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Electricity and Magnetism I (22060411E23)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-411 Students are able to logically and systematically analyze thinking related to Lorentz force (vector analysis), electric current, Biot-Savart Law (vector analysis), divergence, and Curl B. CO-412 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and technology knowledge related to Ampere's Law, magnetic vector potentials, magnetization, types of magnetization materials, magnetized object fields. CO-413 Students are able to apply physical problems and mathematical models in Ampere's Law on material magnetization, Deceptive Parallel, boundary conditions, linear and non-linear media.
Content	1. Lorentz force (Vector analysis) 2. Electric Current 3. Biot Savart's Law (vector analysis) 4. divergence and Curl B 5. Ampere's Law, 6. Magnetic vector potential 7. Magnetization 8. Type of magnetizing material 9. Field of a magnetized object 10. Ampere's law on the magnetization of materials 11. Deceptive Parallel, boundary conditions 12. Linear and non-linear media
Examination forms	Paper Based Test. Project Report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	J. R. Reitz," *Foundations of Electromagnetic Theory*", Addison-Wesley Publ., 1993 D. J. Griffith," *Introduction to Electrodynamics*", Prentice-Hall Inc.,1989. J. D. Jackson," *Classical Electrodynamics*", John Wiley & Sons Inc., 1991 Roaid K Wangsness," *Electromagnetic Fields*", 2nd edition , John Wiley & Sons Inc., 1991 *Names of textbooks, articles, etc.*

SIGNAL PROCESSING (22060411E25)

Module designation	Signal Processing
Semester(s) in which the module is taught	4^{th} Semester
Person responsible for the module	Utiya Hikmah, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Mathematical Physics I (22060411E13)
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK].

CO	CO-421 Students are able to logically and systematically analyze thinking in signal theory and its types. CO-422 Students are able to apply concepts about system classification, analog and digital signals, basic signal operations. CO-423 Students are able to apply physical problems and mathematical models in convolution and Z-transformation. CO-424 Students are able to apply physical problems and mathematical models in potential applications of Fourier transformation and filters (FIR and IIR).
Content	Definition and types of signals Classification of systems in signal processing Discrete signals and digital signal basic operations Convolution Fourier Transform Z-transform FIR and IIR
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	John W.Leis. Digital Signal Processing Using Matlab for Students and Researcher. Wiley, 2011. Shlomo Engelberg. Digital Signal Processing. Springer, 2008. Harlianto Tanudjaja. Pengolahan Sinyal Digital & Sistem Pemrosesan Sinyal. Penerbit Andi, 2007. Dadang Gunawan & Filbert Hilman Juwono. Pengolahan Sinyal Digital Dengan Pemrograman Matlab. Graha Ilmu, 2012. Wilson Jefriyanto, Utiya Hikmah, Moch. Wisnu Arif Sektiono, Restu Lestari, Zainul Anwar dan Hendro, Rancang bangun neraca digital untuk mengetahui massa material penyusun alloy, Prosiding SKF 2016 Shinji Hara, Tetsuya Iwasaki, Yutaka Hori, Robust stability analysis for LTI system with generalized frequency variables and its application to gene regulatory networks, Automatica 105 (2019) 96-106

INTRODUCTION TO NUCLEAR PHYSICS (22060411E26)

Module designation	Introduction to Nuclear Physics
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Wiwis Sasmitaninghidayah, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning, Project Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Modern Physics (22060411E19)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-04 Able to develop networks and work together in teams based on scientific ethics to produce scientific ideas based on science and technology. [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-431 Students are able to logically and systematically analyze thinking about atomic nucleus structure and properties. CO-432 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and technology knowledge related to radioactivity, types of radioactive decay. CO-433 Students are able to analyze technology knowledge in relevant problems about ionizing radiation and nuclear reactions. CO-434 Students are able to apply physical problems and mathematical models in physics in nuclear reactor technology.
Content	Particles and constituents of the atomic nucleus, size and shape of the nucleus, angular momentum and magnetic momentum of the nucleus, force between nucleons, stability of the nucleus, stable binding energy of the nucleus, Weiszacker's empirical formula, basic quantities of radioactivity, sequential decay, radioactive balance, radioactive series, artificial radioactivity, Alpha decay, Beta decay, Gamma decay, Ionizing radiation (ionization process, classification of ionizing radiation, Electromagnetic radiation, electromagnetic radiation energy, x-rays, radiation resulting from nuclear decay, other ionizing radiation, decay scheme), Types of nuclear reactions, Mechanisms of nuclear reactions , Low energy kinematics, Nuclear reaction parameters, particle families, nuclear interaction processes, nuclear fission processes, simultaneous neutrons and cascading neutrons, fission rate and reactor power, neutron folding and cycling in reactors, neutron lifetime, diffusion equation, criticality equation, critical mass , moderator and reflector).
Examination forms	Paper Based Test, Project Report

Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Sarwono,djoko. 1994. Fisika Inti Pendahuluan. Malang: UMpress. Syarip, 2018. Pengenalan Kinetika & Pengendalian reactor Nuklir, Yogyakarta: Pustaka Pelajar. Akadi, Mukhlis. 2000. Dasar-dasar Proteksi Radiasi. Jakarta; Rineka Cipta. Beiser, Arthur. 1982. Konsep Fisika Modern. Jakarta : Erlangga. Krane, Kenneth. 1992. Fisika Modern. Jakarta: Erlangga.

OPTICS (22060411E27)

Module designation	Optics
Semester(s) in which the module is taught	5^{th} Semester
Person responsible for the module	Dr. Mokhammad Tirono, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning, Project Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Waves (22060411E21)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-441 Students are able to logically and systematically analyze thinking in light optics and technology based on Islamic ethics. CO-442 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and technology knowledge in the concept of interference and polarization. CO-443 Students are able to apply theoretical concepts of classical and modern physics, mathematical methods, and technology knowledge in the Fresnel relation concept. CO-444 Students are able to analyze technology knowledge in relevant problems related to thin films. CO-445 Students are able to apply physical problems and mathematical models in physics in the field of electro-optics.
Content	*1.* Fermat's Principle *2.* Paraxial Light *3.* Optical Matrix *4.* Mixed System And Resonator Stability *5.* Superposition of Two Waves, *6.* Interferometers, *7.* Interference of Two Oblique Waves, *8.* Multiwave Interference; *9.* Plane Wave Vector, *10.* John Vector, *11.* John Matric, *12.* Coordinate Transformation, *13.* Normal Variety, *14.* Polarizing Material;
Examination forms	Paper Based Test, Project Report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Daniel A. Steck, 2008, Classical and Modern Optics, Oregon Center for Optics and Department of Physics, University of Oregon, Eugene, Oregon 97403-1274 dsteck@uoregon.edu Saleh B. E. A. dan Teich M.C., 2007, Fundamentals of Photonics, John Wiley & Sons, Inc, Hoboken New Jersey, Canada Gerrant R. Fowles, 1989, Introduction to Modern Optics, Dover Publications, I. C., Newyork

EXPERIMENTAL PHYSICS I (22060411E28)

Module designation	Experimental Physics I
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Wiwis Sasmitaninghidayah, M.Si Muthmainnah, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50” x 4 week per Semester 170” x 12 week per semester (Practicum)
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week. 4. Practicum : 170 minutes per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Fundamental of Physics II (22060411E05)

Module objectives/intended learning outcomes	PLO-02 Able to build a responsible attitude, spirit of independence, and entrepreneurship according to their field of expertise [S] PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-04 Able to develop networks and work together in teams based on scientific ethics to produce scientific ideas based on science and technology. [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]
CO	CO-451 Students are able to apply responsibility, develop innovative thinking, and disseminate classical physics-based practical results. CO-452 Students are able to develop teamwork spirit based on scientific ethics, analyze technology knowledge, and disseminate physical phenomena and problems in Modern Physics experiments. CO-453 Students are able to compile scientific study results in accordance with scientific principles and disseminate them related to optics experiments.

Content	1. Provision regarding SOPs for equipment operation and laboratory K3 2. Experiment 1: Specific Electron Charge (e/m) 3. Experiment 2: Stationary Ultrasonic Waves, Wavelength Determination 4. Experiment 3: Current Scales: Forces Acting on Current-Carrying Conductors 5. Experiment 4: Viscosity of Newtonian and Non-Newtonian Fluids (Rotary Viscometer) 6. Experiment 5: Dielectric Constant of Different Materials 7. Experiment 6: Determination of Optical Speed of Sound in Fluids 8. Experiment 7: Semiconductor Thermogenerator 9. Experiment 8: Electron Absorption (β-) 10. Experiment 9: Dependence of Resistors and Diodes on Temperature 11. Experiment 10: Interference of Ultrasonic Waves with Lloyd's Mirror 12. Experiment 11: Absorption of Ultrasonic Waves in Air 13. Experiment 12: Impulse Induction Using Cobra 3
Examination forms	Project Report, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Operation manual of physics experiment (PHYWE). LEP 5.1.02-00: Specific charge of the electron – e/m LEP 4.4.03-11: Inductance of Solenoids with Cobra3 LEP 4.1.06-01/15: Current balance / Force acting on a current-carrying conductor LEP 1.4.03-00: Viscosity of Newtonian and non-Newtonian liquids (rotary viscometer) LEP 4.2.06-00: Dielectric Constant of Different Materials LEP 1.5.10-00: Optical determination of velocity of sound in liquid LEP 4.1.07-00: Semiconductor Thermogenerator LEP 5.2.31-00: Electron Absorbtion (β^-). LEP 4.1.04-01/15: Temperature dependence of different resistors and diodes LEP 1.5.20-00: Interference of Ultrasonic Waves by a Lloyd Mirror LEP 1.5.14-00 *Absorption of ultrasonic in air*. LEP 4.4.12-11: Induction Impulse

EXPERIMENTAL PHYSICS II (22060411E29)

Module designation	Experimental Physics II
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Cecep Rustana, Ph, D.
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50" x 8 week per Semester 170" x 8 week per semester (Practicum)
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week. 4. Practicum : 170 minutes per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Experimental Physics I (22060411E25)
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO-461 Able to project a spirit of independence in accordance in a mechanics-based practicum CO-462 Able to develop innovative and independent thinking to realize technopreneurship CO-463 Able to develop a spirit of cooperation in a team based on scientific ethics CO-464 Students are able to analyze quantitatively and qualitatively in an electronics-based practicum CO-465 Able to compile scientific study results according to the principles of physics science
Content	1. Introduction to practical equipment in the laboratory 2. Laboratory K3 principles 3. FFII-1: Determination of the Refractive Index of Solutions Using an Abbe Refractometer 4. EFII-2: Tensile Strength Testing of Composite Materials 5. EFII-3: Determination of Resistivity Below Ground Surface Using a Resistivitymeter 6. EFII-4: Measurement of Chlorophyll A, B Levels Using a Vis-Spectrophotometer 7. EFII-5: Hardness and Microstructure Testing of Metal Materials 8. EFII-6: Impedance Measurement Using RCL Meter 9. EFII-7: Liquid Viscosity Testing Using Snb Digital Viscometer 10. EFII-8: Briquette heat testing using a Bomb Calorimeter
Examination forms	Project Report, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Modul Practicum Eksperimen Fisika II, Program Studi Fisika Fakultas Sains dan Teknologi UIN Maulana Malik Ibrahim Malang, 2022 2. Buku Pedoman Umum Pelaksanaan Kesehatan dan Keselamatan Kerja di Gedung (K3G) di Ruang Kantor, Ruang Kerja, Laboratorium Pendidikan dan Penelitian, Program Studi Teknik Fisika Fakultas Teknologi Industri Institut Teknologi Bandung, 2022

QUANTUM PHYSICS (22060411E30)

Module designation	Quantum Physics
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Arista Romadhani, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative Learning 3 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 3. Private learning : 2 x 60 = 180 minutes (3 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Matematical Physics II (22060411E14)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-471 Students are able to analyze quantum physics theory in physical phenomena. CO-472 Students are apply theoretical concepts of correlate particle wave dualism in quantum physics problems. CO-473 Students Able to analyze knowledge about Schrodinger's equations that conform to hypotheses in quantum physics CO-474 Students Able to apply physical problems and mathematical models in the Schrodinger equation and the Hydrogen Atom
Content	FOUNDATIONS OF QUANTUM THEORY ● Thermal Radiation and Theoretical Formulation of Black Body Radiation ● Photoelectric Effect ● Compton effect WAVES – PARTICLES ● De Broglie's hypothesis ● Matter Waves ● Wave Function Interpretation ● Heisenberg's Uncertainty Principle SCHRÖDINGER'S EQUATION ● Time Dependent Schrödinger Equation ● Stationary State Schrödinger Equation ● Expectation Prices, Operators, Functions and Eigenprices APPLICATION OF THE SCHRÖDINGER EQUATION ● Free Particles ● One-Dimensional Potential Boxes And Ground States ● Potential Ladder ● Breakthrough Effect ● Reflection and Transmission Coefficient ● Harmonic Oscillator HYDROGEN ATOMS ● Schrödinger's Equation for the Hydrogen Atom: Azimuthal Equation, Polar Equation, Radial Equation ● Angular Momentum ● Radial Probability Meeting ● Zeemann Effect and Stern – Gerlach Experiment Intrinsic Spin and Total Angular Momentum
Examination forms	Paper Based Test

Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Yahya, Eddy. *Fisika Kuantum*. ITSPress. 2012 Purwanto, Agus. Fisika Kuantum. Penerbit Gava Media Griffith, David. Introduction to Quantum Mechanic. Pearson Education. 2005

THERMODYNAMICS (22060411E31)

Module designation	Termodynamics
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Irjan, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 3 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 3. Private learning : 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Mathematical Physics II (22060411E14)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[.[P]. PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science

CO	CO-481 Able to Able to analyze thoughts logically and systematically in in the development of science and technology of thermodynamics, including thermodynamic systems, system states, system pressures, thermal equilibrium, temperature, temperature measurement, and processes in thermodynamics. CO-482 Able to apply theoretical concepts in physics science state equations in PvT and non-PvT systems, i work and the Law of Thermodynamics I in various thermodynamic processes, including configuration work and dissipative work. CO-483 Able to analyze knowledge in the Law II of thermodynamics and the concept of entropy, laws I and II of thermodynamics in simple and multivariate thermodynamic systems, the potential of thermodynamics and their application. CO-484 Able to apply physical problems and mathematical models in physics science

Content	1. Scope of thermodynamics: Thermodynamic system, System state, System pressure, Thermal equilibrium, Temperature, Thermodynamic temperature measurement, Ideal gas temperature, Celsius, Fahrenheit, Reamur and Rankin thermometers, International temperature scale, Processes in thermodynamics. 2. Equations of State: Relationships between state variables, PvT system state equations, non-PvT system state equations, Differential state functions of PvT and non-PvT systems, Relationships between partial differentials, Exact differentials. 3. Work and the First Law of Thermodynamics: Quasistatic processes in thermodynamics, Work in PvT systems, Work in non-PvT systems, Configuration Work, Dissipative Work, Heat and the First Law of Thermodynamics, Specific Heat, Heat of phase transformations and enthalpy, Energy equation for stationary states . 4. Consequences of the First Law of Thermodynamics: Energy equation with independent variables T and v, T and P, P and v, in the PvT system, Gay Lussac-Joule experiment and Joule-Thomson experiment, Reversible adiabatic process for ideal gases, Carnot Cycle, Machines heat and cooling machines. 5. Second Law of Thermodynamics and Entropy: Thermodynamic temperature, Entropy, Changes in entropy in reversible and irreversible processes, Clausius and Kelvin Planck's statement about the Second Law of Thermodynamics. 6. Combination of Laws I and II of Thermodynamics: PvT system with T and V as independent variables, T and P as independent variables, P and V as independent variables, Tds equation, properties of pure substances, properties of ideal gases, properties of van der Waals gases, Properties of liquids and solids under hydrostatic pressure, Joule and Joule-Thomson experiments, Multivariate systems. 7. Thermodynamic Potential: Helmholtz function and Gibbs function, Thermodynamic Potential, Maxwell

	Relations, Stable and metastable equilibrium, Phase transitions, Clausius-Clapeyron Equation, Third Law of Thermodynamics. 8. Application of Thermodynamics to simple systems: Chemical potential, phase equilibrium and phase rules, pressure relationships
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. F. W. Sears and G. L. Salinger, 1975, Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Addison-Wesley. 2.Richard E. Sonntag and Gordon J. Van Wylen, 1991, Introduction To Thermodynamics Classical And Statistical, University of Michigan. John Wiley & Sons, New York, Chichester Brisbane Toronto, Singapore. 3.Merle C. Potter, Ph,D and Craig W. Somerton, Ph,D. ,1993, Schaum's Outline Of Theory And Problems Of Thermodynamics For Engineers. Professor of Mechanical Engineering Michigan State University. 4.Thermodynamics and Statistical Mechanics An Integrated Approach, 2014, Robert J. Hardy and Christian Binek Department of Physics, University of Nebraska-Lincoln, USA.

RESEARCH METHODS (22060411E32)

Module designation	Research methods
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Dr. Imam Tazi, M.Si Dr. Mokhamad Tirono, M.Si Dr. Erna Hastuti, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Inquiry Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-02 Able to build a responsible attitude, spirit of independence, and entrepreneurship according to their field of expertise [S] PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-04 Able to develop networks and work together in teams based on scientific ethics to produce scientific ideas based on science and technology. [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-491 Able to project a spirit of independence in accordance with his/her field of expertise CO-492 Able to analyze thoughts logically and systematically in the development of science and technology CO-493 Able to develop a spirit of cooperation in a team based on scientific ethics CO-494 Able to analyze knowledge about technology in relevant problems CO-495 Able to compile scientific study results according to the principles of physics science CO-496 Able to disseminate the results of scientific studies in oral and written communication according to the field of physics.
Content	1. Science (Science), 2. Scientific Method, 3. Types of Research, 4. Research Methods, 5. Research Design, 6. Topic, Title and Research Problem, 7. Background, Objectives and Uses of Research, 8. Literature Review, 9. Preparation of Thinking Framework and Hypothesis, 10. Population and Sample, 11. Proposals and Research Reports, 12. Research Results.
Examination forms	Oral presentation Test, Project report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Moh. Nazir, Ph.D, 2014, Metode Penelitian, cetakan ke 10, Bogor, Penerbit Ghalia Indonesia Dr. Ir. Masyhuri, MP. dan Drs. Zainuddin, MA., 2008, Metodologi Penelitian (Pendekatan Praktis dan Aplikatif), cetakan pertama, Bandung, Penerbit PT. Refika Aditama

STATISTICAL PHYSICS (22060411E33)

Module designation	Statistical Physics
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Irjan, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 3 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 3. Private learning : 3 x 60 = 120 minutes (3 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Modern Physics (22060411E19), Thermodynamics (22060411E31)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-501 Able to analyze thoughts logically and systematically in the development of science and technology the scope of statistical physics, the basics of gas kinetic theory, molecular flux, ideal gas state equations, and classical theory of type heat. CO-502 Students are Able to apply theoretical concepts transport phenomena in gases, including the force of attraction between molecules, van der Waals gas state equations, impact latitude appearance, freeway distribution, viscosity coefficient, thermal conductivity, and diffusion. CO-503 Students are Able to analyze knowledge the concepts of statistical thermodynamics, including energy and energy levels, energy quantization, macro and micro states, thermodynamic probabilities, and Bose-Einstein, Fermi-Dirac, and Maxwell-Boltzmann statistics in the analysis of monoatomic ideal gases, Bose-Einstein gases, and Fermi-Dirac gases. CO-504 Able to apply physical problems and mathematical models in physics science

Content	1. Introduction: Scope of Statistical and Assemble Physics. 2. Kinetic Theory of Gases: Basic Assumptions, Molecular flux, Equation of state of an ideal gas, classical theory of specific heat. 3. Transport Phenomena: Intermolecular attraction forces, Van der Waals gas equation of state, Collision cross section, free path distribution, Viscosity coefficient, Thermal conductivity, Diffusion. 4. Statistical Thermodynamics: Energy and energy levels, Quantization of energy, Macrostates and micro states, Thermodynamic Probability, Bose-Einstein Statistics, Fermi-Dirac Statistics, Maxwell-Boltzmann Statistics, Distribution function, Boltzmann partition function, Degeneration in phase space. 5. Monatomic Ideal Gas: Macro energy levels, Degeneracy of macro energy levels, Molecular speed distribution, Most probable speed, average speed, rms speed, Error function, Height function particle distribution, Energy equipartition principle in M-B statistics. 6. Bose-Einstein gas: Distribution of gas molecules, Photon gas and black body radiation, Wien radiation law, Rayleigh-Jeans formula, Stefan-Boltzmann law, Einstein theory and Debye theory for the specific heat capacity of solids. 7. Fermi-Dirac Gas: Distribution of gas particles, Electron gas.
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. F. W. Sears and G. L. Salinger, 1975, Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Addison-Wesley. 2. Richard E. Sonntag and Gordon J. Van Wylen, 1991, Introduction To Thermodynamics Classical And Statistical, University of Michigan. John Wiley & Sons, New York, Chichester Brisbane Toronto, Singapore. 3. .Tony Guénault, 2007, Statistical Physics Second Revised and Enlarged Edition, Emeritus Professor of Low Temperature Physics Lancaster University, UK. Springer. 4. Kerson Huang, 2010, Introduction To Statistical Physics. Second Edition, CRC Press. London New York. 5. R. K. Pathria and Paul D. Beale, 2011, Statistical Mechanics Third Edition Department of Physics University of California at San Diego. Elsevier. 6. Thermodynamics and Statistical Mechanics An Integrated Approach, 2014, Robert J. Hardy and Christian Binek Department of Physics, University of Nebraska-Lincoln, USA.

INTRODUCTION TO SOLID STATE PHYSICS (22060411E34)

Module designation	Introduction to Solid State Physics
Semester(s) in which the module is taught	6st Semester
Person responsible for the module	Dr. Erna Hastuti, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 3 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 3 x 50 = 150 minutes per week. 2. Exercises and Assignments : 3 x 60 = 180 minutes (3 hours) per week. 3. Private learning : 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 SKS ~ 4.41 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Modern Physics (22060411E19), Thermodynamics (22060411E31)
Module objectives/intended learning outcomes	PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK]

CO	CO-511 Able to analyze thoughts logically and systematically in the development of science and technology, to apply the concept of solids and their development in science and technology CO-512 Students are able to analyze physical symptoms about crystal structure, crystal diffraction and reciprocating lattices CO-513 Students are Able to analyze knowledge about concepts and mathematical methods to bonds between atoms and crystal dynamics CO-514 Students are Able to apply physical problems on the concept of electrons in metals, insulators, semiconductors and their application in science
Content	1. Basis and crystal structure and Miller indices. 2. X-ray diffraction of crystals. 3. Basic ideas of bonding in solid state 4. Dynamic crystal 5. Electronic conduction in metals, classical free electron theory, quantum theory of free electrons, band theory of solids 6. semiconductors and insulators
Examination forms	Paper Based Test
Study and examination requirements	Cognitive: Midterm exam, Final exam, Quizzes, Assignments Psychomotor: Practice Affective: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. Erna, Umayyah, Diktat Pendahuluan Fisika Zat Padat 2. Kittel, Charles, Introduction to Solid State Physics, John Wiley & Sons Inc 3. William Calliester, Materials Science and Engineering, John Wiley & Sons Inc, 4. Omar, M.A., *Elementary Solid State Physics*, Addison Weley, London. 5. Blackmore, *Solid State Physics*, Edition, Cambridge University Press.

PHYSICS SEMINAR (22060411E35)

Module designation	Physics Seminar
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Dr. Imam Tazi, M.Si Dr. Mokhamad Tirono, M.Si Irjan, M.Si Dr. Erna Hastuti, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project based learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Research Method (22060411E32)
Module objectives/intended learning outcomes	PLO-02 Able to build a responsible attitude, spirit of independence, and entrepreneurship according to their field of expertise [S] PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-04 Able to develop networks and work together in teams based on scientific ethics to produce scientific ideas based on science and technology. [KU] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-521 Students are Able to project a spirit of independence in completing tasks according to their field of expertise in physics CO-522 Students are Able to develop innovative and independent thinking in the development of science and technology based on Islamic ethics CO-523 Student are Able to develop in prepare research proposals as implications for the development of science and technology according to the field of expertise in physics CO-524 Able to analyze alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and science. CO-525 Able to compile scientific study results according to the principles of physics science CO-526 Able to disseminate the results of scientific studies in oral and written communication according to the field of physics.
Content	-
Examination forms	Project Report Oral presentation test
Study and examination requirements	Cognitive: Midterm exam, Final exam, Quizzes, Assignments Psychomotor: Practice Affective: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	-.

ENTREPRENEURSHIP (22060411E36)

Module designation	Entrepreneurship
Semester(s) in which the module is taught	4th Semester
Person responsible for the module	Dr. M Tirono, M.Si Ahmad Luthfin, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project based learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-02 Able to build a responsible attitude, spirit of independence, and entrepreneurship according to their field of expertise [S] PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-04 Able to develop networks and work together in teams based on scientific ethics to produce scientific ideas based on science and technology. [KU] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-531 Students are Able to build an entrepreneurial spirit according to his/her field of expertise CO-532 Students are Able to develop innovative and innovative thinking in entrepreneurship and Basic Principles of Islamic Economics, SWOT analysis related to business opportunities that will be the topic of practice, Making Business proposals CO533 Students are Able to build networks to produce scientific ideas based on science and technology CO534 Able to develop a spirit of cooperation in a team based on scientific ethics CO535 Able to disseminate the results of scientific studies in oral and written communication according to the field of physics.
Content	1. Science of entrepreneurship and entrepreneurship 2. Characteristics of entrepreneurship. 3. Think creatively, innovatively 4. Determine Business Opportunities 5. Leadership and Motivation 6. Determination of Superior Products & Innovation Management 7. Organizational Management and Performance Evaluation 8. Basic Principles of Islamic Economics 9. SWOT analysis related to business opportunities which will be a practical topic 10. Making business proposals 11. Entrepreneurship Practices 12. Entrepreneurship Practices
Examination forms	Oral presentation test Project report
Study and examination requirements	Cognitive: Midterm exam, Final exam, Quizzes, Assignments Psychomotor: Practice Affective: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Suryana. 2013. Kewirausahaan kiat dan proses menuju sukses edisi 4. Jakarta: Salemba Empat. 2. Saragih, Rintan, 2013. Berwirausaha Cerdas, Inspirasi bagi kaum muda, Yogyakarta;.Graha Ilmu. 3. Saifan, S.A, 2012, Social Entrepreneurship: Definition and Boundaries. Technology Innovation Management Review 4. Wawan D., Hendrati,D,M., Anggraeni,P.,Grisns,A.,Indriyani, A, 2013, Inovasi dan Kewirausahaan Sosial. Panduan Dasar Menjadi Agen Perubahan, Bandung; Alfabeta 5. Bornstein,D, 2004, How to Change the World: Social Entrepreneur and the Power of New Idea. Oxford; Oxford University Press Dees, J. G , 2001, The Meaning of Social Entrepreneurship

UNDERGRADUATE THESIS (22060411E37)

Module designation	Undergraduate Thesis
Semester(s) in which the module is taught	7^{th} Semester
Person responsible for the module	Dr. Imam Tazi, M.Si Irjan, M.Si
Language	Indonesian
Relation to curriculum	Compulsory Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project based learning Inquiry based learning 6 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 6 x 50 = 300 minutes per week. 2. Exercises and Assignments : 6 x 60 = 360 minutes (6 hours) per week. 3. Private learning : : 6 x 60 = 360 minutes (6 hours) per week.
Credit points	6 SKS ~ 8.82 ECTS
Required and recommended prerequisites for joining the module	Each student have to attend at least 75% of the number of lectures to be able to take the exam Course Prerequisite: Research Method (22060411E32), Seminar Physics (22060411E35)
Module objectives/intended learning outcomes	PLO-02 Able to build a responsible attitude, spirit of independence, and entrepreneurship according to their field of expertise [S] PLO-03 Able to develop logical, systematic, innovative and independent thinking in science and technology to support technopreneurship based on Islamic values [KU] PLO-04 Able to develop networks and work together in teams based on scientific ethics to produce scientific ideas based on science and technology. [KU] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-541 Students are Able to project a spirit of independence in identify relevant physics problems and choose the right research topic based on literature review and the latest developments in physics. CO-542 Students are Able to analyze thoughts logically and systematically in scientific literature to strengthen the theoretical and methodological foundations in thesis research. CO-543 Students are Able to apply Islamic values in the development of science and technology CO-544 Students are Able to build networks, develop appropriate and systematic research methods, both for experimental, theoretical, and simulation research. CO-545 Students are Able to develop and apply appropriate data collection techniques, either through experiments, observations, or simulations independently. CO-546 Students are able to analyze data quantitatively or qualitatively using appropriate methods, as well as draw valid conclusions based on the results of the analysis. CO-547 Students are able to compile and disseminate the results of their research orally and in the form of scientific papers CO-548 Able to disseminate the results of scientific studies in oral and written communication according to the field of physics.
Content	-
Examination forms	Oral presentation test Project based test
Study and examination requirements	Proposal Presentation, Comprehenship Examination, Result Seminar and Final Seminar
Reading list	-.

THEORY OF SPECIAL RELATIVITY (22060411F01)

Module designation	Theory of Special Relativity
Semester(s) in which the module is taught	5th
Person responsible for the module	Arista Romadani
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project based learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-551 Students are able to apply, analyze physical symptoms and problems about special relativity theories and supporting experiments. CO-552 Students analyze theoretical concepts and mathematical methods of formulating Galileo's transformation and its physical implications. CO-553 Able to apply physical problems and mathematical models in physics science CO-554 Students are able to analyze, predict the potential application of physical behavior, the basic concept of special relativity theory CO-555 Able to formulate physical problems and alternative solutions in technology and the field of physics CO-556 Able to compile scientific study results according to the principles of physics science CO-557 Able to disseminate the results of scientific studies in oral and written communication according to the field of physics.
Content	1. Historical background of the Special Theory of Relativity 2. Relative motion in classical and modern perspective 3. Galileo's Transformation 4. Michelson-Morley experiment 5. Basic postulates of the Special Theory of Relativity 6. Lorentz transformations and their implications 7. Events and simultaneity 8. Long Contraction 9. Time dilation 10. Twin paradox 11. Relativistic Doppler effect 12. Relativistic dynamics 13. Space-time structure 14. Tensor Algebra 15. Electrodynamics
Examination forms	Paper based Test

Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. Purwanto, A., 2011, Teori relativitas Khusus, ITS Press, Surabaya 2. Anugraha, R., 2011, Teori Relativitas dan Kosmologi, UGM Press, Yogyakarta 3. Singh, R.B., 2009, introduction to modern physics volume 1, New Age International Publishers, New Delhi

INTRODUCTION OF ASTROPHYSICS AND COSMOLOGY (22060411F02)

Module designation	Introduction of Astrophysics and Cosmology
Semester(s) in which the module is taught	5^{th}
Person responsible for the module	Arista Romadani
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project based learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-561 Students are able to apply the theoretical concepts of physics about radiation, the theory of relativity and the concept of gravity in relevant problems. CO-562 Students are able to analyze physical symptoms and problems about stars, black holes, and cosmic phenomena of the universe. CO-563 Students able to apply and predict the potential application of the laws of physics in astronomy, astrophysics and cosmology. CO-564 Able to analyze alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and science CO-565 Able to formulate physical problems and alternative solutions in technology and the field of physics CO-566 Able to compile scientific study results according to the principles of physics science CO-567 Able to disseminate the results of scientific studies in oral and written communication according to the field of physics.
Content	1. History of the development of astronomy and astrophysics 2. Basic concepts of astronomy (astrophysics) 3. Kepler's law 4. Elliptic equation, Radiation theory 5. Intensity, Flux 6. Luminosity, Black body radiation 7. Introduction to the theory of relativity 8. Doppler shift 9. Solar system, Evolution of stars 10. Classification of stars, Einstein's concept of gravity 11. Einstein's field equations 12. Black holes (black holes) 13. Introduction to modern cosmology
Examination forms	Paper based Test

Study and examination requirements	Cognitive: Midterm exam, Final exam, Quizzes, Assignments Psychomotor: Practice Affective: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. Rinto A., 2011, Teori Relativitas dan Kosmologi, Yogyakarta, UGM Press 2. Eka G.S., 2010, Astronomi dan Astrofisika, Makassar 3. Arista R., 2016, Lubang Hitam Schwarzschild pada Perluasan teori relativitas Umum, Yogyakarta, Thesis UGM 4. Arnab Rai, C., 2010, Astrophysics for Physicist, UK, Cambridge University Press 5. M.F Rosyid, Pengantar Astrofisika dan Astronomi.

INTRODUCTION OF PARTICLE PHYSICS (22060411F03)

Module designation	Introduction of Particle Physics
Semester(s) in which the module is taught	6th
Person responsible for the module	Muhammad Taufiqi
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: Mathematical Physics (22060411E14)
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-571 Students are able to apply the theoretical concepts of the particles that make up the universe and fundamental interactions in relevant problems. CO-572 Students are able to analyze fermion and boson particles with theoretical and experimental approaches. CO-573 Students are able to apply and predict the application of physical behavior from hadron particles CO-574 Able to analyze alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and science CO-575 Able to formulate physical problems and alternative solutions in technology and the field of physics CO-576 Able to compile scientific study results according to the principles of physics science CO-577 Able to disseminate the results of scientific studies in oral and written communication according to the field of physics.
Content	Historical background of fundamental particles and their accompanying interactions. Introduction to the standard model: includes fermions (quarks and leptons) and the experiments that include them. Fundamental forces and the gauge bosons that represent them. The study continues with the shortcomings of the standard model in explaining several experimental results, followed by efforts to correct these deficiencies.
Examination forms	Paper based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	David J. Griffiths, Introduction to elementary particles, Harper & Row, New York, ©1987 Brian R. Martin, Graham Shaw, Particle Physics (Manchester Physics Series), Brian R. Martin (Author), Graham Shaw

GROUP THEORY (22060411F04)

Module designation	Group Theory
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Muhammad Taufiqi
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: Mathematical Physics (22060411E14)
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-581 Students are able to Apply basic concepts such as definitions, terms, types, and group algebra. CO-582 Students are able to analyze group properties such as isomorphism, homomorphism, permutation, abelian, cyclic & di-cyclic, uniter, orthogonal CO-583 Students are able to apply mathematical tools of group theory in physics problems CO-584 Able to analyze alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and science CO-585 Able to formulate physical problems and alternative solutions in technology and the field of physics CO-586 Able to compile scientific study results according to the principles of physics science CO-587 Able to disseminate the results of scientific studies in oral and written communication according to the field of physics.
Content	Basic Group Theory, including the terms groups, subgroups, group order, co-sets, etc. Also discusses types of groups, such as orthogonal groups, unitary groups, etc.
Examination forms	Paper based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. Teturo Inui , Yukito Tanabe , Yositaka Onodera, Group Theory and Its Applications in Physics, Springer Berlin, Heidelberg 2. John F. Cornwell, Group Theory in Physics: An Introduction (Volume 1) (Techniques of Physics, Volume 1), Academic Press; Abridged edition (August 7, 1997)

GENERAL RELATIVITY THEORY (22060411F05)

Module designation	General relativity Theory
Semester(s) in which the module is taught	6^{th}
Person responsible for the module	Arista Romadani, M.Sc
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: Theory of Special Relativity (22060411F01)
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-591 Students are able to explain and apply the concept of gravity from the perspective of Newton and Einstein as well as the principle of equivalence of general relativity CO-592 Students were able to derive and analyze Einstein's field equations, the formulation of Christoffel Symbols, Riemann-Christoffel Tensors, Ricci Tensors and Ricci Scalars, and Geodesic Equations. CO-593 Students are able to predict and apply the application of mathematical equations in the case of black holes, gravitational waves, and cosmology. CO-594 Able to analyze alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and science CO-595 Able to formulate physical problems and alternative solutions in technology and the field of physics CO-596 Able to compile scientific study results according to the principles of physics science CO-597 Able to disseminate the results of scientific studies in oral and written communication according to the field of physics.
Content	Gravity in classical and modern perspectives, Principle of equivalence (equality), Tensor Algebra, Tensor Analysis, Christoffel Symbol, Riemann-Christoffel Tensor, Ricci Tensor and Ricci Scalar, Geodesic Equations, Einstein Field Equations, Schwarzschild Black Holes, Gravitational Waves, Basics cosmology
Examination forms	Paper based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Anugraha, R., 2011, Teori Relativitas dan Kosmologi, UGM Press, Yogyakarta 2. Carroll, S. M., 2004. Space Time and Geometry: An Introduction of General. Relativity, Adison Wesley. Cembranos, J.A.R 3. B. Schutz, “A First Course in General Relativity”, 2nd Edition, Cambridge University Press, 2009 4. Arista R., 2016, Lubang Hitam Schwarzschild pada Perluasan teori relativitas Umum, Yogyakarta, Thesis UGM 5. W. Rindler, “Relativity: Special, General and Cosmological”, 2. ed., reprinted., Oxford u.a. Oxford Univ. Press, 2009

QUANTUM MECHANICS (22060411F06)

Module designation	Quantum Mechanics
Semester(s) in which the module is taught	6th
Person responsible for the module	Arista Romadani, M.Sc
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: Quantum Physics
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO 601-Students are able to explain and apply the concept of mathematical formalism and its interpretation in the formulation of quantum mechanics CO 602-Students are able to analyze the case problems of the hydrogen atom and physical concepts such as spin and angular momentum CO 603-Students are able to apply Schrodinger's equations with other approaches such as variation methods, disturbances and WKB CO-604 Able to analyze alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and science CO-605 Able to formulate physical problems and alternative solutions in technology and the field of physics CO-606 Able to compile scientific study results according to the principles of physics science CO-607 Able to disseminate the results of scientific studies in oral and written communication according to the field of physics.

Content	1. Introduction to formal aspects of mathematics and interpretation of several expressions in the quantum mechanical formulation of n-dimensional abstract vector spaces and the properties of related linear operations 2. Introduction to formal aspects of mathematics and interpretation of several expressions in the formulation of quantum mechanics 3. Orbital angular momentum, properties of representing operators and solving eigenvalue problems 4. Eigenvalues for angular momentum generally use the up-down operator method and the concept of spin angular momentum 5. Introduction to the concept of angular momentum coupling and the Clebsch-Gordan coefficient 6. Several examples of physical systems involving angular momentum coupling (L-S and J-J coupling) and methods for solving them 7. Introduction to several approximation methods, variational methods and timeless Perturbation methods 8. Introduction to several approximation methods, namely the time-dependent Perturbation method 9. Introduction to several approximation methods, namely the WKB method and its application for solving molecular systems 10. Introduction to several approximation methods, namely central field, self-consistent field method or Hartree-Fock method 11. Application of the Hartree-Fock method and its application to many body problems for fine and hyper-fine structures for complex atoms
Examination forms	Paper based Test
Study and examination requirements	Cognitive: Midterm exam, Final exam, Quizzes, Assignments Psychomotor: Practice Affective: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Griffiths, D.J., 2005, Introduction to Quantum Mechanics, Pearson Education Inc.(Reissued by Cambridge University Press, 2017) 2. ConstantineSKS, F., & Magyari, E., 1971, Problems in Quantum Mechanics, Pergamon Press 3. Sakurai, J.J., 1985, Modern Quantum Mechanics, Benjamin/Cummings 4. Tannoudji, C.H., et al, 1977, Quantum Mechanics Vol.I & II., John Willey 5. David McMohan, 2006, Quantum Mechanics, McGraw Hill 6. Kusminarto, Pokok Pikiran Fisika Kuantum, UGM 7. Rustam, E.S. 2018, Fisika Kuantum, Jatinangor, Fisika Unpad

ADVANCED COMPUTATIONAL (22060411F07)

Module designation	Advanced Computational Physics
Semester(s) in which the module is taught	7th
Person responsible for the module	Muhammad taufiqi, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project based learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-611 Students are able to analyze mathematical formulations of classical bits, the principle of superposition and quantum bits. CO-612 Students are able to formulate entangled states and classical and quantum logic gates. CO - 613 Students are able to disseminate theoretical reviews of the basics of Qiskit, the Deutsch-Jozsa algorithm, and the Shor algorithm.
Content	Quantum States, Entangled States, Logic Gates, Quantum Algorithms, Qiskit
Examination forms	Paper based Test, Project
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. M. Nakahara, Introduction to Quantum Computing 2. Thomas G Wong, Introduction to classical and quantum computing

CAPITA SELECTA IN THEORETICAL PHYSICS (22060411F08)

Module designation	Capita Selecta in Theoretical Physics
Semester(s) in which the module is taught	7^{th}
Person responsible for the module	Arista Romadani, M.Sc.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: Quantum Physics (22060411E30)
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-621 Students are able to analyze basic knowledge or concepts that support research topics. CO-622 Students are able to formulate mathematical analysis to solve physical system problems. CO-623 Students are able to disseminate phenomena that occur in nature
Content	Based on research from lecturer, for example quantum gravity: 1. Review the general theory of relativity 2. Black holes 3. Schwarzschild Metric 4. Kruskal Szekeres coordinates 5. Neutron stars 6. Modification of gravity: f(R) theory of gravity 7. Schwarzschild solution in the theory of gravity f(R) 8. Kruskal-Szekeres coordinates in the theory of gravity f(R) 9. Fokker-Planck equation in Brownian motion theory 10. Langevin's equation in the theory of Brownian motion 11. Relativistic Brownian motion 12. Brownian motion in the Schwarzschild metric 13. Klein-Gordon equation on the Schwarzschild metric 14. Dirac equation on the Schwarzschild metric
Examination forms	Oral presentation test, Paper based test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Anugraha, R., 2011, Teori Relativitas dan Kosmologi, UGM Press, Yogyakarta 2. Carroll, S. M., 2004. Space Time and Geometry: An Introduction of General. Relativity, Adison Wesley. Cembranos, J.A.R 3. Arista, 2016, Lubang Hitam Schwarzschild Pada Perluasan Teori Relativitas Umum, Yogyakarta, UGM 4. Arista, 2013, Teori Gerak Brown pada (1+3)-dimensi, Yogyakarta, UGM 5. Arista dan Erika, 2020, Pengaruh Medan Elektromagnet terhadap Partikel Dirac dan Klein-Gordon dalam Potensial Penghalang Periodik Satu Dimensi, Journal of Physical Science and Engineering, http://journal2.um.ac.id/index.php/jpse EISSN: 2541-2485 6. Dunkel & Hanggi, 2006, Theory of the Relativistic Brownian Motion. The 1+1-Dimensional Case, arXiv:cond-mat/0411011v2 7. Dunkel & Hanggi, 2005, Theory of the Relativistic Brownian Motion. The (1+1)-Dimensional Case, arXiv:cond-mat/0505532v1

RELATIVISTIC QUANTUM THEORY (22060411F09)

Module designation	Relativistic Quantum THEORY
Semester(s) in which the module is taught	7th
Person responsible for the module	Arista Romadani, M.Sc. Muhammad taufiqi, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Requirements: Quantum Physics (22060411E30)
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-631 Students are able to analyze the basic concepts of the theory of relativity and mechanics as well as the motivation for the birth of the quantum theory of relativity. CO-632 Students are able to formulate the Klein-Gordon Dirac equation CO-633 Students are able to disseminate theoretical reviews of Klein's paradox, pair production processes, Weyl's equation, etc.
Content	Historical and fundamental background of the special theory of relativity, motivation and development of the Klein Gordon and Dirac equations, solutions and problems of these two equations, as well as applications to the case of free particles and simple systems such as potential boxes.
Examination forms	Paper based Test, oral presentation test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. Lawrence P. Horwitz, Relativistic Quantum Mechanics, Springer Netherlands, 2015 2. Hartmut Pilkuhn, Relativistic Quantum Mechanics, Springer Berlin Heidelberg 2013

QUANTUM FIELD THEORY (22060411F10)

Module designation	Quantum Field Theory
Semester(s) in which the module is taught	7th
Person responsible for the module	Muhammad taufiqi, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: Quantum Physics (22060411E30)
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. [KK] PLO-08 Able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science. [KK]

CO	CO-641 Students are able to analyze concepts about field theory and field quantization. CO-642 Students are able to formulate the Lagrangian formulation of quantum field theory as well as the mathematical formulation of interactions between particles and fields. CO-643 Students are able to disseminate theoretical reviews of gauge invariance, perturbation theory and renormalization.
Content	Lagrangian formulation of quantum field theory, mathematical formulation of interactions between particles and fields, gauge invariance, and effective field theory and renormalization.
Examination forms	Paper based Test, oral presentation test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. A. Zee, Quantum Field Theoryp in a Nutshell, Princeton University Press, 2010 2. A. Zee, Quantum Field Theory, as Simply as Possible, Princeton University Press, 2023

SENSOR DAN TRANSDUCER (22060411F11)

Module designation	Sensor and Transducer
Semester(s) in which the module is taught	5th
Person responsible for the module	Dr. Imam Tazi, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Students are able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Students are able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO-651 Students are able to apply selected sensor and transducer capital, static and dynamic characteristics, and physical principles underlying sensor operations for various applications. CO-652 Students are able to formulate various types of sensors, including position and displacement sensors, acoustic sensors, vibration, speed, acceleration, pressure, force, torque, temperature, flow, optics, humidity, wetness, and radiation detectors, and apply these sensors in measurement systems. CO-653 Students are able to disseminate sensor system projects, data loggers for practical applications, and how to calibrate sensors.
Content	1. Capita selecta sensors and transducers 2. Static Characteristics 3. Physical Principles 4. Dynamic Characteristics 5. Position and Shift Sensor 6. Acoustic, (Vibration), Speed and Acceleration Sensors 7. Pressure, Force and Torque Sensors 8. Temperature Sensor 9. Flow Sensor 10. Optical Sensor (Light Detector) 11. Humidity and Wetness Sensor 12. Radiation Detector 13. Project task is to create a sensor and data logger system
Examination forms	Paper based test, Project report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Pallas-Areny, R., Webster, John G., 1991, Sensors and Signal Conditioning, John Wiley & Sons, Inc., New York. 2. Fraden, J., 2004, Handbook Of Modern Sensors : Physics, Designs, and Applications, 3/ed, Springer Science + Business Media, LLC, New York. 3. Doebelin, Ernest O., 1990, Measurement Systems : Application and Design, 4/ed, McGraw-Hill Publishing Company, New York.

CONTROL SYSTEM (22060411F12)

Module designation	Control System
Semester(s) in which the module is taught	5th
Person responsible for the module	Farid Samsu H, MT
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Students are able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Students are able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO-661 Students are able to analyze the introductory concepts of control systems, Laplace transforms, and block diagrams. CO-662 Students are able to formulate the concept of open and closed control systems, signal flow diagrams, and system responses. CO-663 Students are able to analyze the concept of system stability, control systems in mechanics, and control systems in electricity. CO-664 Students are able to disseminate and apply the concept of Proportional-Integral-Derivative (PI, PD, PID) control in designing control systems to achieve the desired performance.
Content	1. Introduction to control systems 2. Laplace Transform 3. Block diagram 4. Open and COsed control system 5. Signal flow diagram 6. System response 7. Frequency response 8. System stability 9. Mechanical control system 10. Electrical control system 11. Compensator in the control system 12. PI, PD, PID control
Examination forms	Project report, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Dorsey John, 2002, Continuous and Discrete Control Systems, Singapore : Mc Graw Hill 2. Gopal M., 2003, Control Systems principles and design, Singapore : Mc Graw Hill. 3. Kuo Benjamin C., 1998, Teknik Kontrol Automatik, Jakarta : Simon & Schuster (Asia) Pte Ltd. 4. Philips Charles L, Harbor Royce D., 1998, Sistem Kontrol, Dasardasar, Jakarta : Prenhalindo 5. Philips Charles L, Harbor Royce D., 1998, Sistem Kontrol, Lanjutan, Jakarta

ELECTRIC MOTOR (22060411F13)

Module designation	Electric Motor
Semester(s) in which the module is taught	6th
Person responsible for the module	Farid Samsu Hananto, M.T
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	4. Lectures : 2 x 50 = 100 minutes per week. 5. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 1. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Students are able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Students are able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO-671 Students are able to analyze knowledge about electric motors. CO-672 Students are able to formulate the DC motors and their control. CO-673 Students are able to disseminate AC motors and their controls.
Content	Comparison of analog and digital systems 1. Audio Amplifier 2. Signal processing with OP-Amp 3. Diode, Transistor and Thyristor 4. Switches and Relays 5. Analog to digital and Digital to Analog conversion 6. Radio Frequency Amplifier 7. Radio Communication 8. Electronic Filter 9. Signal Generation 10. Power Supply
Examination forms	Project Report, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. Austin Hughes, 2006, Electric motors and drive, Newnes, Singapore 2. Eddy Prihatno, 2019, Teknik Dasar Pengendalian Motor Listrik, Penerbit Gava Media, Yogyakarta.

MICROCONTROLLER (22060411F14)

Module designation	Microcontroller
Semester(s) in which the module is taught	6th
Person responsible for the module	Muthmainnah, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Students are able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Students are able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO-681 Students are able to analyze the concept of microcontroller introduction as well as Arduino IDE installation and microcontroller configuration. CO-682 Students are able to formulate the concept of LED operation, programming of temperature sensors (LM35, DHT) and air and soil humidity. CO-683 Students are able to formulate programming concepts to display sensor results on LCD, distance sensors, optical sensors, and gas sensors. CO-684 Students are able to disseminate the concept of Internet of Things (IoT) programming for monitoring and control.
Content	1. Introduction to microcontrollers 2. Arduino IDE installation and microcontroller configuration 3. Turning on led, flashing led, running led and red light application 4. Control the led with a push button 5. Programming the LM35, DHT temperature sensor 6. Programming air and soil humidity sensors 7. Programming displays sensor results on the LCD 8. proximity sensor programming 9. Optical sensor programming 10. Gas sensor programming 11. IoT programming for monitoring 12. IOT programming for control
Examination forms	Oral Presentation Test, Project Report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Abdul Kadir, 2015, From Zero to Pro arduino, Panduan Mempelajari Aneka Proyek Berbasis Mikrokontroler 2. Muhammad Syahwil, 2014, Panduan Mudah Simulasi dan Praktek Mikrokontroler Arduino. Yogyakarta : Andi Offset 3. Muhammad Syahwil, 2017, Panduan Mudah Belajar Arduino Menggunakan Simulasi Proteus. Yogyakarta: Andi Offset 4. Iswanto, ST, M.Eng, 2017, Buku Belajar Mikrokontroler AT89S51 dengan bahasa basic, Universitas Muhammadiyah Yogyakarta

ANALOG ELECTRONICS (22060411F15)

Module designation	Analog Electronics
Semester(s) in which the module is taught	6th
Person responsible for the module	Farid Samsu Hananto, M.T
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisites: electronic 1
Module objectives/intended learning outcomes	PLO-05 Students are able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Students are able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO-691 Students are able to analyze knowledge about the role of analog technology in electronic circuits. CO-692 Students are able to formulate the use of analog electronic components in electronic systems. CO-693 Students are able to disseminate analog technology in radio transmission.
Content	Comparison of analog and digital systems 1. Audio Amplifier 2. Signal processing with OP-Amp 3. Diode, Transistor and Thyristor 4. Switches and Relays 5. Analog to digital and Digital to Analog conversion 6. Radio Frequency Amplifier 7. Radio Communication 8. Electronic Filter 9. Signal Generation 10. Power Supply
Examination forms	Oral Presentation Test, Project Report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	D. Crecraft dan S. Gergely,2002, Analog Electronics (Circuits, Systems and Signal Processing), Newness

INTERFACING (22060411F16)

Module designation	Interfacing
Semester(s) in which the module is taught	6th
Person responsible for the module	Muthmainnah, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Students are able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Students are able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO-701 Students are able to analyze knowledge about the history and development of microprocessors and microcontrollers. CO-702 Students are able to analyze the architecture and basic organization of computer CPUs. CO-703 Students are able to formulatet programming languages for interfacing computers and microcontrollers. CO-704 Students are able to disseminate several computer-based controls by utilizing a microcontroller as an interface.
Content	1. Introduction to computer/laptop ports 2. Development environment for PC/laptop and Arduino interaction 3. Arduino and Matlab configuration 4. Arduino I/O programming with Matlab 5. PWM and Analog Input 6. I2C displays 7. SPI programming. 8. DC motor control 9. Servo motor control 10. Reading Sensors 11. LM35 temperature sensor 12. RPM sensor 13. Stran gauge sensor 14. COsed control system
Examination forms	Oral Presentation Test, Project Report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Embeded microcomputer system, realtime interfacing, Jonahtan w. Valvano , 2011 2. Arduino Programming with Matlab, Agus Kurniawan, 2015 3. Matlab support package for arduino, Matlab user guide, 2014 4. Embeded microcomputer system, realtime interfacing, Jonahtan w. Valvano , 2011

MODERN OPTICS (22060411F17)

Module designation	Modern Optics
Semester(s) in which the module is taught	6th
Person responsible for the module	Wiwis Sasmitaninghidayah, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -

Module objectives/intended learning outcomes	PLO-05 Students are able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Students are able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.
CO	CO-715 Student are able to analyze about modern optics and its applications CO-717 Student are able to formulate alternative solutions in technology and the field of modern optics CO-718 Student are able to disseminate the potential application of physical behavior according to the field of modern optics
Content	geometric optics, physical optics, waveguides, lasers, and nonlinear optics
Examination forms	Oral Presentation Test, Project Report
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Saleh, Teich, 'Fundamenals of Photonics', Wiley (1992). 2. Hecht, 'Optic', Addison-Wesley (2001) 3. Mansuripur, 'Classical Optics and its Applications', Cambridge (2002) 4. Menzel, 'Photonics', Springer (2000) 5. Lipson, Lipson, Tannhäuser, 'Optik'; Springer (1997) 6. Born, Wolf, 'Principles of Optics', Pergamon 7. Pertsch, Thomas.2015. Fundamentals of Modern Optics. Friedrich-Schiller-Universitat Jena 8. R. Hidayat dan M. O. Tjia, Optika Modern: propagasi cahaya dan proses optik dalam bahan dan struktur fungsional, 2012

ROBOTICS (22060411F18)

Module designation	Robotics
Semester(s) in which the module is taught	7th
Person responsible for the module	Farid Samsu Hananto, M.T
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam. **Course Prerequisite:** sensors course
Module objectives/intended learning outcomes	PLO-05 Students are able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Students are able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.
CO	CO-721 Student are able to analyze about robot components CO-722 Student are able to implement hardware for simple robots CO-723 Student are able to disseminate software for simple robots

Content	History and Development of Robots 1. Types of Robots 2. Robot Components 3. Robot Control 4. Robot Sensors and Actuators 5. Robot Programming 6. Robot Design with Arduino 7. Simple Robot making project
Examination forms	Paper-based Test, project
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, **Assignments Psychomotor:** Practice **Affective:** Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Taufiq Dwi Septian Suyadhi, 2020, Buku Pinter Robotika, Penerbit Andi Publisher, Yogyakarta

ARTIFICIAL INTELLIGENCE (22060411F19)

Module designation	Artificial Intelligence
Semester(s) in which the module is taught	6th
Person responsible for the module	Dr. Imam Tazi, M.Si
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project based learning, Problem based learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam. **Course Prerequisite:** sensor and tranducer (22060411F11)
Module objectives/intended learning outcomes	PLO-05 Students are able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Students are able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO-731 Student are able to analyze basic concepts of artificial intelligence, simple network architecture, and development of network architecture for applications in neural network systems and biology CO-732 Student are able to formulate various algorithms and methods in artificial intelligence, including the McCulloch Pitts Algorithm, Decision Tree Algorithm, Perceptron Method, Backpropagation Method, and Gradient Descent with Adaptive Learning Rate (traingda), in developing and training AI models CO-733 Student are able to disseminate and optimize artificial intelligence models using incremental and batch modes, as well as understanding activation functions used in artificial neural networks.
Content	Capita Selekta Artificial intelligence 1. nervous tissue system, biological system 2. simple network architecture 3. Development of network architecture 4. Activation functions 5. McCulloch Pitts Algorithm 6. HEBB Network Algorithm 7. Perceptron Method 8. Backpropagation Method 9. Gradient descent with Adaptive Learning Rate (traingda) 10. Incremental Mode and Batch Mode
Examination forms	Paper-based Test, project, oral presentation test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, **Assignments Psychomotor:** Practice **Affective:** Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. Stuart J. Russel and Peter Norfig, 2003, Artificial Intellegence - A Modern Approach , Prentice-Hall International. 2. George F Luger, 2002, Artificial Intellegence - Structures and Strategies for Complex, Problem Solving, Addison-Wesley.

ELECTRONICS WORKSHOP (22060411F20)

Module designation	Electronics Workshop
Semester(s) in which the module is taught	7th
Person responsible for the module	Farid Samsu Hananto, M.T
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning, cooperative, inquiry based learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam. **Course Prerequisite:** -
Module objectives/intended learning outcomes	PLO-05 Students are able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Students are able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO741- Able to analyze work safety concepts in the laboratory CO742- Able to formulate PCB designs using software CO743- Able to implement PCB designs into ready-to-use PCBs CO744- Able to disseminate circuit errors and perform troubleshooting
Content	1. Basics of occupational safety 2. Introduction to work tools 3. PCB Design with Eagle/PCB Wizard 4. Layout and manufacture of PCB screens 5. PCB pattern screen printing technique 6. Drilling and installing components on the PCB 7. Electronic work (soldering and desoldering) 8. Test the circuit function 9. Troubleshooting 10. Independent project
Examination forms	Paper-based Test, project, oral presentation test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, **Assignments Psychomotor:** Practice **Affective:** Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	J.M Hughes, 2015, Practical electronics: Componen and Techniques, O'Reilly Media, USA

SEISMOLOGY (22060411F21)

Module designation	Seismology
Semester(s) in which the module is taught	5^{th}
Person responsible for the module	Rusli, M.Si
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam. **Course Prerequisite:** waves (22060411E21)
Module objectives/intended learning outcomes	PLO-05 Students are able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems. PLO-07 Students are able to formulate physical problems, mathematical models, and alternative solutions that are in accordance with hypotheses based on the results of observations and experiments in the fields of technology and physics science. PLO-08 Students are able to disseminate the results of scientific studies in oral and written communication according to the rules of physics science.

CO	CO-751 Students are able to analyze concepts about seismology, plate kinetic theory, wave theory and body waves CO-752 Students are able to formulate alternative solutions in technology and the scientific field of physics, especially related to surface waves, seismographs, earthquake magnitude and earthquake intensity. CO-753 Students are able to disseminate the potential application of physical behavior according to the scientific field of physics, especially related to DSHA, PSHA, tsunamis and liquefaction
Content	1. Concept of seismology 2. Plate tectonic theory, 3. Wave Theory 4. Body waves, 5. Surface waves 6. Seismograph 7. Magnitude of the earthquake 8. Earthquake intensity 9. DSHA 10. PSHA 11. Tsunami 12. Liquefaction
Examination forms	Paper-based Test, project report, oral presentation test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, **Assignments Psychomotor:** Practice **Affective:** Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. Pawirodikromo, Widodo. 2012. Seismologi Teknik dan Rekayasa Kegempaan. Yogyakarta, Pustaka Pelajar. 2. Towhata, Ikuo. 2008. Geotechnical Earthquake Engineering. Berlin, Springer. 3. Shearer, P.M. 1999. Introduction Sesimology. United Kingdom, Cambridge University Press. 4. Huang, Yu dan Miao Yu. 2017. Hazard Analysis of Seismic Soil Liquefaction. Singapore, Springer. 5. Rusli, dkk. 2010. Pemodelan Tsunami sebagai Bahan Mitigasi Bencana Studi Kasus Sumenep dan Kepulauannya. Malang, Jurnal Neutrino vol.2, no.2.

PETROLEUM GEOLOGY (22060411F22)

Module designation	Petroleum Geology
Semester(s) in which the module is taught	5th
Person responsible for the module	Drs. Abdul Basid, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning, Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam. **Course Prerequisite:** -
Module objectives/intended learning outcomes	PLO-05 Students will get an understanding of the theory behind both modern and classical physics, as well as mathematical techniques, technology knowledge, and its application to relevant problems PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-761 Students are able to implement knowledge about petroleum geology, especially related to the process of oil and natural gas formation, the composition and benefits of oil and natural gas, and the negative impacts of the use of oil and natural gas. CO-762 Students are able to analyze alternative solutions in technology and the scientific field of geophysics, especially mechanisms and products produced from oil and gas processing, source rock mechanisms and deposit formation and mechanisms for migration, accumulation and maturation of oil and natural gas. CO-763 Students are able to predict the potential application of physical behavior according to the scientific field of geophysics, especially oil and gas exploration mechanisms, oil and gas exploration techniques on land, sea and offshore, and the development of oil basins in Indonesia
Content	1. The process of forming oil and natural gas 2. Composition and benefits of oil and natural gas 3. Negative impacts of the use of oil and natural gas 4. Mechanisms and products produced from oil and gas processing 5. Mechanism of source rock and deposit formation 6. Mechanism of migration, accumulation and maturation of oil and gas 7. Oil and gas exploration mechanisms 8. Oil and gas exploration techniques on land, sea and offshore. 9. Development of oil basins in Indonesia.
Examination forms	Paper-based Test, project report, oral presentation test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, **Assignments Psychomotor:** Practice **Affective:** Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Chapman, R.E., 1976, Petroleum Geology, Second Reprint, Elsevier Scr. Publishing Co., New York 2. Lowell, J.D., 1985, Structural Styles in Petroleum Geology, Oil and Gas Consultant International Inc, Pebul., Tulsa, Oklahoma. 3. Mopdy, G.B., 1961, Handbook of Petroleum Geology, Mc Graw Hill Book Co., New York. 4. Pirson, S.J., 1963, Handbook of Well Log Analysis and Oil and pGas Gas Formation Evaluation, Prentice Hall Inc., Engle wood Clifts, New York

VOLCANOLOGY AND GEOTHERMAL (22060411F23)

Module designation	Volcanology and Geothermal
Semester(s) in which the module is taught	6th
Person responsible for the module	Ahmad Luthfin, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning, Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam. **Course Prerequisite:** -
Module objectives/intended learning outcomes	PLO-05 Students will get an understanding of the theory behind both modern and classical physics, as well as mathematical techniques, technology knowledge, and its application to relevant problems PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-771 Student are able to implement knowledge about plate tectonic theory, types of volcanoes, volcanic activity, volcanic eruptions & volcanic intrusions. CO-772 Student are able to analyze magmatism, volcanic facies, volcanic mitigation, geodynamics and internal structure of the earth CO-773 Student are able to predict potential geothermal manifestations on the surface, geothermal geology, geochemical geochemistry, application of geophysical methods for volcanoes and geothermal
Content	1. Plate tectonic theory 2. Volcano type 3. Volcanic Activity. 4. Volcanic Eruption & Volcanic Intrusion. 5. Magmatism 6. Volcanic facies 7. Volcano mitigation 8. Geodynamics and internal structure of the earth 9. Geothermal manifestations on the surface 10. Geothermal geology 11. Geothermal geochemistry 12. Application of geophysical methods for volcanoes and geothermal
Examination forms	Paper-based Test, project report, oral presentation test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, **Assignments Psychomotor:** Practice **Affective:** Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Marti, Joan, Gerald Ernst. 2015. Volcanoes and the environment. Cambridge, Cambridge University Press. 2. Lockwood, John P., Richard W. Hazlett. 2016. Volcanoes Global Perspektives. UK, Wiley Blackwell. 3. Francis, peter., Clive Openheimer. 2014. Volcanoes. Oxford. Oxford University Press. 4. Sumotarto, Untung, 2015. Eksplorasi Panas Bumi. Yogyakarta, Ombak. 5. Stober, Ingrid., Kurt Bucher. 2016. Geothermal Energy from Theoritical Models to Exploration and development. London, Springer. 6. Gupta, Harsh., Sukanta Roy. 2011. Geothermal Energy an Alternative Resource for the 21st Century. Amsterdam, Elsevier.

SEISMIC EXPLORATION (22060411F24)

Module designation	Seismic Exploration
Semester(s) in which the module is taught	6^{th}
Person responsible for the module	Irjan, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning, Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam. **Course Prerequisite:** waves (22060411E21)
Module objectives/intended learning outcomes	PLO-05 Students will get an understanding of the theory behind both modern and classical physics, as well as mathematical techniques, technology knowledge, and its application to relevant problems PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-781 Student are able to implement knowledge about the history of the development of seismic exploration, Rock Elastic Constants and Seismic Wave Propagation Speed: Types of rock elastic constants, Seismic Waves: Definition of Seismic Waves, Seismic Wave Propagation Speed, Seismic Wave Attenuation, Seismic Wave Amplitude, Seismic Wave Partition CO-782 Student are able to analyze the trajectory of seismic waves in the earth's layers: Huygen's Principle, Fermat's Principle, Seismic Wave Refraction, Seismic Wave Reflection, Seismic Wave Diffraction, Seismic Wave Sources and Seismic Wave Detection Equipment: Types of Seismic Wave Sources, Geophones and Hydrophones, Seismic Refraction: Models Horizontal Interface, Dipping Interface Model, Field Procedures, Refraction Seismic Data Processing, Refraction Seismic Data Interpretation CO-783 Student are able to predict the potential application of Seismic Reflections: Horizontal Interface Model, Dipping Interface Model, Field Procedures, Processing Seismic Reflection Data, Interpretation of Seismic Reflection Data, Seismic Attributes: AI, AVO

Content	1. Introduction: History of the development of seismic exploration. 2. Rock Elastic Constants and Seismic Wave Propagation Speed: Types of rock elastic constants. 3. Seismic Waves: Definition of Seismic Waves, Seismic Wave Propagation Speed, Seismic Wave Attenuation, Seismic Wave Amplitude, Seismic Wave Partition. 4. Path of seismic waves in the earth's layers: Huygen's Principle, Fermat's Principle, Seismic Wave Refraction, Seismic Wave Reflection, Seismic Wave Diffraction. 5. Seismic Wave Sources and Seismic Wave Detection Equipment: Types of Seismic Wave Sources, Geophones and Hydrophones. 6. Seismic Refraction: Horizontal Interface Model, Dipping Interface Model, Field Procedures, Refraction Seismic Data Processing, Refraction Seismic Data Interpretation. 7. Seismic Reflection: Horizontal Interface Model, Dipping Interface Model, Field procedures, Processing seismic reflection data, Interpreting seismic reflection data. 8. Seismic Attributes: AI, AVO
Examination forms	Paper-based Test, project report, oral presentation test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, **Assignments Psychomotor:** Practice **Affective:** Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. Douglas C. Buger, H.Robert Burger, 1992, Exploration Geophysisc of the Shallow Subsurfase. Prentice Hall PTR, Upper Saddle River, New Jersey. 2. Telford, W.M., Geldart LP., Sheriff, RE., 1990, Applied Geophysics, Canbirdge University press,2nd edition. 3. Gerard T. Schuster, 2007, Basics of Seismic Wave Theory, University of Utah. 4. John M. Reynolds, 2011, An Introduction to applied and environmental Geophysics, Willey-Blackwell. 5. Hamid N.Alsadi, 2017, Seismic Hydrocarbon Exploration 2D and 3D Techniques, Springer.

GRAVITY FIELDS AND GEOMAGNETIC EXPLORATION (22060411F25)

Module designation	Gravity Fields and Geomagnetic Exploration
Semester(s) in which the module is taught	6^{th}
Person responsible for the module	Rusli, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning, Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam **Course Prerequisite:** Electricity and Magnetism II (22060411E24)
Module objectives/intended learning outcomes	PLO-05 Students will get an understanding of the theory behind both modern and classical physics, as well as mathematical techniques, technology knowledge, and its application to relevant problems PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-791 Student are able to implement knowledge about Introduction to gravity methods, Gravitational field theory, Gravitimeter, Gravitational data acquisition CO-792 Student are able to analyze alternative solutions in technology and the scientific field of physics Gravity data processing, Interpretation of gravity data, Introduction to geomagnetic methods, Geomagnetic field theory CO-793 Student are able to predict the potential application of Magnetometers, acquisition of geomagnetic data, processing of geomagnetic data, interpretation of geomagnetic data
Content	1. Introduction to the gravity method 2. Gravitational field theory 3. Gravitimeter 4. Acquisition of gravity data 5. Gravity data processing 6. Interpretation of gravity data 7. Introduction to geomagnetic methods 8. Geomagnetic field theory 9. Magnetometers 10. Geomagnetic data acquisition 11. Geomagnetic data processing 12. Interpretation of geomagnetic data
Examination forms	Paper-based Test, project report, oral presentation test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	1. Hinze, William J. Dkk. 2015. Gravity and Magnetic Exploration Principle Practices and Aplication. Cambridge, Cambridge University Press. 2. Blakely, R. J. 1996. Potential Theory in Gravity and Magnetic Aplications. United Kingdom, Cambridge University Press. 3. Kaufman, A. A., Hansen R. O. 2013. Principles of the Gravitational Method. Amsterdam, Elsevier. 4. Kaufman, A. A. dkk. 2014. Principles of the Magnetic Methods in Geophysics. Amsterdam, Elsevier

METEOROLOGY AND CLIMATOLOGY (22060411F26)

Module designation	Meteorology and Climatology
Semester(s) in which the module is taught	7^{th}
Person responsible for the module	Rusli, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning, Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam
Module objectives/intended learning outcomes	PLO-05 Students will get an understanding of the theory behind both modern and classical physics, as well as mathematical techniques, technology knowledge, and its application to relevant problems PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-801 Student are able to implement knowledge about Meteorology and Climatology, Atmosphere, Atmospheric Heating, Air Temperature, Air Pressure. CO-802 Student are able to analyze wind, air humidity, precipitation, climate control CO-803 Student are able to predict potential climate classification, climate change, acid rain, global warming
Content	1. Meteorology and Climatology 2. Atmosphere 3. Atmospheric Warming 4. Air Temperature 5. Air Pressure 6. Wind 7. Air Humidity 8. Precipitation 9. Climate control 10. Climate classification 11. Climate change 12. Acid rain 13. Global warming
Examination forms	Paper-based Test, project report, oral presentation test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	1. Utoma, D.H. 2018. Meteorologi dan Klimatologi. Yogyakarta, Magnum Pustaka Utama. 2. Ahrens, C. Donald, 2018. Essentials of Meteorology An Invitation to the Atmosphere. USA, Brook Cole. 3. Ahrens, C. Donald. 2006. Meteorology Today, An Introduction to Weather, Climate and The Environtmen. Australia, Thomson, Brooks-Cole 4. Prawirowardoyo, 1996. Meteorologi. Bandung,Penerbit ITB.

STRATIGRAPHY AND STRUCTURAL GEOLOGY (22060411F27)

Module designation	Stratigraphy and Structural Geology
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Irjan, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50” x 2 time x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Students will get an understanding of the theory behind both modern and classical physics, as well as mathematical techniques, technology knowledge, and its application to relevant problems PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-821 Students are able to classified Stratigraphy: Earth's interior, Sedimentary Environment, Sedimentary Sequence and depositional contacts, Facies and Lithofacies, Sea Level Changes, Track Systems and Seismic Sequence Analysis, Types of Internal Configuration of Seismic Facies, Classification of Hydrocarbon Stratigraphic Traps CO-822 Students are able to analyze Structural Traps: Plate Tectonics, Fold Structure Traps, Fracture Structures, Fault Structures, Salt Dome Structures, Classification of Hydrocarbon Trap Structures CO-823 Students are able to predict the potential application of physical behavior according to the field of physics relevant to Stratigraphy and Structural Geology
Content	1. Stratigraphy: Earth's interior, Depositional Environment, Depositional Sequences and Depositional Contacts, Facies and Lithofacies, Sea Level Changes, Track Systems and Seismic Sequence Analysis, Types of Internal Configuration of Seismic Facies, Classification of Hydrocarbon Stratigraphic Traps. 2. Structure Traps: Plate Tectonics, Fold Structure Traps, Fracture Structures, Fault Structures, Salt Dome Structures, Classification of Hydrocarbon Traps Structures
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Gary Nichols, 1999, Sedimentology and Stratigraphy, Second Edition, Willey-Blackwell. 2. Patrice F. Rey, Introduction to Structural Geology. Additional : 1. Paul.C.H. Veeken, 2007, Seismic Stratigraphy, Basin Analysis And Reservoir Characterisation, First Edition, The Boulevard, Langford Lane, Kidlington, Oxford ,Elsevier. 2. Gerald Schubert, 2007, Seismology and Structure of The Earth. Harvard Unversity, Cambridge. 3. T. K. Datta, 2010, Seismic Analysis of Structures. John Wiley & Sons (Asia) Pte Ltd, 2 Clementi Loop, Singapore. 4. Paul C. H. Veeken and Bruno van Moerkerken, 2013, Seismic Stratigraphy and Depositional Facies Models. Eage. Netherlands.

GEOELECTRIC AND ELECTROMAGNETIC EXPLORATION (22060411F28)

Module designation	Geoelectric and Electromagnetic Exploration
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Ahmad Luthfin, M.Si
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem based learning, Project Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	Lectures : 2 x 50 = 100 minutes per week. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Students will get an understanding of the theory behind both modern and classical physics, as well as mathematical techniques, technology knowledge, and its application to relevant problems PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-811 Students are able to identify electromagnetic exploration, basic wave material, electromagnetic waves and Maxwell's equations, theoretical basis and derivation of telluric and magnetelluric equations, working principles and research acquisition using the MT method, case studies & interpretation of MT method data in a research journal CO-812 Students are able to compare GPR Method, VLF Method, Geoelectric Method CO-813 Students are able to compare Resistivity Method, IP Method, SP Method
Content	1. Introduction: History of the development of geoelectric methods. 2. Electrical Properties of Rocks: Electric potential, Electrical conductivity, and polarization potential. 3. Basic Electrical Concepts: Ohm's Law, Resistivity, Conductivity, Porosity and Permeability. 4. Geoelectric resistivity method: Current flow in an isotropic homogeneous medium, One current electrode, Two Current Electrodes and a Potential Electrode, Electrode configuration and geometric factors, Apparent Resistivity, Sounding and Mapping Measurement Techniques, Interpretation and Application of Geoelectric Resistivity. 5. IP Method: Basic Principles of IP method, Measurement of IP method (Time-Domain and Frequency-domain :), Interpretation and application of IP Method. 6. SP Method: Basic Principles of the SP Method, Measurement of the SP method, Interpretation of self-potential anomalies and Applications of the SP method. Basic principles of VLF, measurement of VLF methods and processing of VLF data, interpretation and application of VLF methods.
Examination forms	Oral Presentation Test

Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main: 1. Douglas C. Buger, H.Robert Burger, 1992, Exploration Geophysisc of the Shallow Subsurfase. 2. Telford, W.M., Geldart LP., Sheriff, RE., 1990, Applied Geophysics, Canbirdge University press,2nd edition. Additional: 1. P. K. Bhattacharya and H. P. Patra, 1968. Direct Current Geoelectric Sounding, Departement of Geology and Geophysics, Indian Institute of Thechnology, Kharagpur, West bengal, India. Elsevier. 2. John M. Reynolds, 2011, An Introduction to applied and environmental Geophysics, Willey-Blackwell. 3. Mark E. Everett, 2013, Near-Surface Applied Geophysics, Cambridge University Press.

GIS AND REMOTE SENSING (22060411F29)

Module designation	**SIG dan Pengindraan Jauh**
Semester(s) in which the module is taught	7th Semester
Person responsible for the module	Drs. Cecep E Rustana, B.Sc Hons., Ph.D
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Inquiry Based Learning 2 x 50” x 2 time x 16 week per Semester Practicum
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Students will get an understanding of the theory behind both modern and classical physics, as well as mathematical techniques, technology knowledge, and its application to relevant problems PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-831 Students are able to identify knowledge of Remote Sensing Physics, Image Interpretation Techniques and Elements, Remote Sensing Photographic Systems, Photogrammetry, Remote Sensing and Thermal Systems, Microwave and Radar Systems. CO-832 Students are able to analyze satellite remote sensing systems, processing and analysis of remote sensing data. CO-834 Students are able to evaluate the basic practices of ER-Mapper, practices of geometric and radiometric correction of remote sensing, practices of increasing image contrast, practices of processing and displaying three-dimensional surface data, practices of applications combining digital images from various sources.
Content	1. General description and functions of the Indonesian language 2. Linguistic Rules 3. Critically examine various information as a pre-writing activity 4. Code of Ethics for Writing Scientific Work 5. Content and Systematics of the Paper 6. Content and Systematics of Scientific Articles 7. Self-editing techniques and publication of scientific articles
Examination forms	Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main: 1. Weng Qihao. 2015. Remote Sensing and GIS Integration, Theory, Methods and Aplication. USA: McGraw-Hill. Additional: 1. Prahasta, Eddy. 2014. Remote Sensing, Praktis Penginderaan Jauh dan Pengolahn Citra Digital dengan Perangkat ER Mapper. Bandung: Informatika. 2. Lo, C.P. 1996. Penginderaan Jauh Terapan. Jakarta: UIP.

FORMATION EVALUATION (22060411F30)

Module designation	Formation Evaluation
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Irjan, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-841 Students are able to identify hydrocarbon nest rocks: Sedimentary rocks, Petrophysical properties of rocks, Introduction to Logging: Basic principles of logging data acquisition, Logging scale, Scope of logging, Basic concepts of resistivity: Impact of drilling mud on invasion zones, Logging Temperature: Subsurface temperature, Borehole temperature, Formation temperature. CO-842 Students are able to analyze the types of logging: Gamma ray logging: The working principle of gamma ray logs, Gamma ray log acquisition, reading gamma ray log curves, Spontaneous Potential (SP) logging: The working principle of SP logs, SP log acquisition, reading SP log curves, Resistivity logging: The working principle of resistivity logs, Resistivity log acquisition, reading resistivity log curves, Density logging: The working principle of density logs, Density log acquisition, reading density log curves, Acoustic logging: The working principle of acoustic logs, Acoustic log acquisition, reading acoustic log curves, Neutron logging: The working principle of neutron logs, Neutron log acquisition, reading neutron log curves CO-843 Students are able to evaluate Data Logging Correction and Data Logging Interpretation: Gamma ray log data correction, SP log data correction, Resistivity log data correction, Density log data correction, Acoustic log data correction, Neutron log data correction, Data Logging Interpretation: Qualitative interpretation, Quantitative interpretation.

Content	1. Hydrocarbon nesting rocks: Sedimentary rocks, Petrophysical properties of rocks. 2. Introduction to Logging: Basic principles of logging data acquisition, Logging scale, Logging scope. 3. Basic concepts of resistivity: Impact of drilling mud on the invasion zone. 4. Temperature Logging: Subsurface temperature, Borehole temperature, Formation temperature. 5. Relationship between petrophysical parameters. 6. Types of logging: Gamma ray logging: Working principle of gamma ray logs, Acquisition of gamma ray logs, reading gamma ray log curves, Spontaneous Potential (SP) Logging: Working principles of SP logs, Acquisition of SP logs, reading SP log curves, Logging resistivity: Working principles of resistivity logs, Acquisition of resistivity logs, reading resistivity log curves, Logging density: Working principles of density logs, Acquisition of density logs, reading density log curves, Acoustic logging: Working principles of acoustic logs, Acquisition of acoustic logs, reading acoustic log curves, Neutron logging: Working principle of neutron log, Acquisition of neutron log, reading neutron log curve, 7. Logging Data Correction and Logging Data Interpretation: Gamma ray log data correction, SP log data correction, Resistivity log data correction, Density log data correction, Acoustic log data correction, Neutron log data correction, Logging Data Interpretation: Qualitative interpretation, Quantitative interpretation .
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Atlas, Dresser, 1992, Well logging and Interpretation, 3 rd edition. Additional : 1. Darwin V. Ellis and Julian M. Singer, 2007, Well Logging for Earth Scientists 2nd Edition, Schlumberger-Doll Research Ridgefield. CT. USA, Richmond, UK, Springer. 2. Jurgen Schon, 2015, Basic Well Logging and Formation Evaluation. First Edition. Prof.Dr.Jurgen Shcon & BookBoon. 3. Hongqi Liu, 2017, Principles and Applications of Well Logging. Petroleum Industry Press and Springer-Verlag Berlin Heidelberg. 4. Schlumberger,___, Chart Interpretation

ANATOMY AND PHYSIOLOGY (22060411F31)

Module designation	Anatomy and Physiology
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Dr. Mokhamad Tirono, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-851 Students are able to identify technology and understand the basic principles of physiology and anatomy, cells, transport systems, fluids. CO-852 Students are able to analyze movement between compartments, genetics, tissue, skeletal system, muscular system CO-853 Students are able to conclude how the heart system, digestive system, and renal system work.
Content	1. Basic scientific principles of physiology, 2. Cells, cellular compartments, transport systems, fluid 3. movement between compartments, 4. Genetics, 5. Tissue, 6. The skeletal system, 7. The muscular system, Circulatory system, 8.The cardiac system, 9. The digestive system 10. The renal system
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. PeAte, I., NaIr, M. 2017, Fundamentals of Anatomy and Physiology, Cambridge University Press Additional : 1. Scanlon, V.C. Sanders, T. 2007. fifth edition of Essentials of Anatomy and Physiology. F. A. Davis Company

RADIATION PHYSICS (22060411F32)

Module designation	Radiation Physics
Semester(s) in which the module is taught	5[nd] Semester
Person responsible for the module	Dr. H. Agus Mulyono S. Pd, M. Kes
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-861 Students are able to identify the mechanisms of cell damage due to physical factors and the basics of radiation physics. CO-862 Students are able to formulate concepts of natural and artificial radiation sources, the effects of low-dose radiation exposure, forensic radiography, and ionizing radiation protection. CO-863 Students are able to analyze the concept of radiopharmaceuticals and the use of ionizing radiation and apply them in a practical context. CO-864 Students are able to evaluate the concept of radiopharmaceuticals and the use of ionizing radiation and apply them in a practical context.
Content	1. Mechanism of cell damage due to physical factors 2. Basics of radiation physics 3. Natural sources of radiation 4. Artificial radiation sources 5. Effects of low dose radiation exposure 6. Ionizing radiation protection 7. Radiopharmaceuticals 8. Use of ionizing radiation 9. Management of radioactive waste 10. Nuclear Program in Indonesia
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Lamarsh, J. 1983. Introduction to Nuclear Engineering. 2nd edition. Addision Wesley Publishing Company. Additional : 1. Cember, H, Johnson, TE. 2009. Introduction to Health Physics. Mc. Graw Hill Medical 2. Gabriel, dr. JF. 1996. Fisika Kedokteran. Fakultas Kedokteran FK Unud. 3. http://www.batan.go.id/pusdiklat/elearning/proteksiradiasi/pengenalan_radiasi/1-3.htm 4. Murray, RL. 2000. Nuclear Energi. An Introduction to the Concepts, Systems and Applications of Nuclear Processes. 5th edition. Butterworth-Heinemann 5. Wardhana, WA. 2007. Teknologi Nuklir : Proteksi Radiasi dan Aplikasinya. Penerbit Andi 6. Hasan Y. 2015. Energi dan Penggunaannya. Batan Press 7. Syaifudin M. 2016. Biologi radiasi. Dasar-dasar dan Aplikasi. BAtan Press 8. Setiawan B. 2016. Pengelolaan Limbah RAdioaktif. Batan Press 9. Alatas Z. 2016. Buku Pintar Nuklir. Batan Press

BIOMECHANICS AND BIOELECTRICS (22060411F33)

Module designation	Biomechanics And Bioelectrics
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Dr. Mokhamad Tirono, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-875 Student are able to master knowledge about technology and its application CO-877 Student are able to analyze alternative solutions in technology and the scientific field of physics CO-878 Student are able to predict the potential application of physical behavior according to the scientific field of physics

Content	1. Human Body Structure Muscles, Tendons, Ligaments, and Bones; 2. Laws of Motion: Snowflakes, Airborne Balls, Pendulums; 3. Particles in Motion: Method of Lumped Masses and Jumping, Sit-Ups, Push-Ups; 4. Bodies in Planar Motion: Jumping, Diving, Push-Ups, Back Curls 5. Sources and Fields : Tissue Resistance and Conductance , Fields and Currents, Duality, Monopole Field, Dipole Field, Capacitance; 6. Bioelectric Potentials: Currents in Solutions, Moles and Amperes, Ionic Composition, Nernst–Planck Equation, Mobility, Flux Due to Diffusion Plus Electric Field Membrane Structure, Nernst Potential, Electrolytes, Parallel-Conductance Model, Contributions from Chloride; 7. Channels: Channel Structure by Electron Microscopy, Channel Structure: Molecular Genetics , Ion Channels Biophysical Methods, Macroscopic, Channel Kinetics, Channel tatistics The Hodgkin–Huxley Membrane Model; 8. Action Potentials : Experimental Action Potentials, Voltage Clamp, Hodgkin–Huxley Conductance Equations, Simulation of Membrane Action Potentials, Beyond H-H Models; 9. Impulse Propagation : Core-Conductor Model, Cable Equations, Propagation, Propagation in Myelinated Nerve Fibers; 10. Electrical Stimulation : Spherical Cell Stimulation, Stimulation of Fibers, Axial Current Transient, Field Stimulus of an Individual Fiber, Stimulus :then Suprathreshold Response, Fiber Input Impedance, Magnetic Field Stimulation 11. Extracellular Fields : Background, Extracellular Potentials from Fibers, Potentials from a Cell; 12. Cardiac Electrophysiology : Intercellular Communication, Cardiac Cellular Models, Electrocardiography
Examination forms	Paper Based Test

Study and examination requirements	***Cognitive****: Midterm exam, Final exam, Quizzes, Assignments* ***Psychomotor****: Practice* ***Affective****: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort*
Reading list	Main : 1. Tözeren A. 1999, Human Body Dynamics: Classical Mechanics and Human Movement, Springer USA 2. Plonsey R., Barr RC., 2007, Bioelectricity A Quantitative Approach, Springer Additional : 1. He B., 2004. Modeling and Imaging of Bioelectrical Activity Principles and Applications , Kluwer Academic/ Plenum Publishers, New York 2. LEVY JH. 2010. BIOMECHANICS: PRINCIPLES, TRENDS AND APPLICATIONS. Nova Science Publishers, Inc. New York

BIOMATERIAL (22060411F34)

Module designation	Biomaterial
Semester(s) in which the module is taught	6^{nd} Semester
Person responsible for the module	Dr. H. Agus Mulyono S. Pd, M. Kes.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-881 Students are able to identify the materials that make up cortical bone, trabecular bone, dentin and enamel and analyze their mechanical properties. CO-882 Students are able to compare the differences between arteries, veins and lymphatic vessels and are able to predict the potential application of the physical and chemical properties of the components within them. CO-883 Students are able to analyze Metal Biomaterials and composite materials and analyze their mechanical properties. CO-884 Students are able to predict the potential application of Thermoplastic Polymers in Biomedical applications. CO-885 Students are able to predict the potential application of physical degradation/resorption behavior in bioactive ceramics in orthopedics and corrosion in metal implants.
Content	1. Cortical Bone 2. Trabecular Bone 3. Dentin and Enamel 4. Blood and Related Fluids 5. Arteries, Veins, and Lymphatic Vessels 6. Metal Biomaterials 7. Composite Materials 8. Thermoplastic Polymers in Biomedical Applications: Structure, Properties and Processing 9. Degradation/Resorption in Bioactive Ceramics in Orthopedics 10. Corrosion of Metal Implants
Examination forms	Oral Presentation Test
Study and examination requirements	***Cognitive****: Midterm exam, Final exam, Quizzes, Assignments* ***Psychomotor****: Practice* ***Affective****: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort*

Reading list	Main : 1. Black, jonathan. 1998. *Handbook of Biomaterial Properties*. Chapman & Hall: New York Additional : 1. Yakin, Khusnul, *et al*. 2020. *Simulation of mechanical stimulation effect on bone density changes due to age-based finite element method (FEM)* . IOP Conference Series: Earth and Environmental Science, 456 (2020)

COMPUTATIONAL BIOPHYSICS (22060411F35)

Module designation	Computational Biophysics
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Dr. H. Agus Mulyono S. Pd, M. Kes.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-895 Student are able to master knowledge about biophysical computing technology and its applications. CO-897 Student are able to analyze alternative solutions in technology and the scientific field of biophysics CO-898 Student are able to predict the potential application of physical behavior according to the scientific field of biophysics
Content	0. Introduction to Matlab and its installation 1. Numerical methods in Matlab: Roots finding, differential, integral, interpolation, matrix press, differential press 2. Data processing with Python: Least square fit, average, statistical error method 3. Oscillatory Motion: Forced Damped Oscillations by Rungekutta Method 4. DFT and FFT 5. Electricity and Magnetism: Magnet's electric field 6. Core Physics (TTM). Module 7: Radioactive decay 7. Thermodynamics (TTM). Module 8: Heat Transfer 8. Physical Optics: Diffraction 9. Quantum Phenomena: 1D Quantum Systems 10. Magnetization: 1D Ising Model 11. Solid Substances: Brillouine Zone
Examination forms	Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Zhilin Li, Zhonghua Qiao, and Tao Tang. 2018. Introduction to Finite Difference and Finite Element Methods. Cambridge University Press : New York Additional : 1. Schiesser, W.E. 2014. Differential Equation Analysis in Biomedical Science and Engineering. John Wiley & Sons : Canada

BIOSENSOR (22060411F36)

Module designation	Biosensor
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Dr. Imam Tazi, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Problem Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-901 Students are able to identify the basic concepts of biosensors, including descriptions, definitions, classifications, and data acquisition, as well as the characteristics and working principles of biosensors for various applications (temperature, tensiometer, pH). CO-902 AStudents are able to analyze the working principles of chemical sensors such as Gluco tests, pregnancy tests, and Rapid Tests, as well as the working principles of analog and digital tensiometers, Surface Plasmon Resonance (SPR), and Fourier Transform Infrared Spectroscopy (FTIR) for biosensors. CO-903 Students are able to design biosensor technology in the development of electronic tongues and electronic noses, as well as conduct critical reviews of the latest journals on biosensors.
Content	1. Biosensor capita selecta 2. Description, Definition, Classification, Data Acquisition 3. Characteristics of biosensors 4. Working principle of biosensor sensors (temperature, tensimeter, pH) 5. Working principle of Chemical sensors (Gluco test, Pregnancy test kit, Rapid Test) 6. Working principle of analog and digital blood pressure meters 7. Working principle of Surface Plasmon Resonance (SPR) for bio sensors 8. Working principle of FTIR for biosensors 9. Electronic Tongue 10. Electronic Nose 11. Review of the latest journals about Biosensors
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Adib, Mohammad. 2011. Filsafat Ilmu Ontologi, Epistemologi, Aksiologi, dan Logika Ilmu Pengetahuan. Yogyakarta: Pustaka Pelajar. J ujun S. Suriasumantri. 2005. *Filsafat Ilmu: Sebuah Pengantar Populer.* Jakarta: Pustaka Sinar Harapan. Bakhtiar, Amsal. *Filsafat Ilmu*, 2004. Jakarta: Rajawali Press. Liang Gie. Filsafat Ilmu. 1991. Yogyakarta. Studi Ilmu Teknologi. In'am Esa, Filsafat Ilmu. Malang: UIN Pess. Zainuddin, Filsafat Ilmu. Malang: UIN Press Al-Faruqi, Ismail Razi. 1988. *Islamisation of Knowledge: General Principles and Work Plan Herdon*. Washington VA IIT. Golshani, Mehdi. 2011. *The Holy Qur'an and Sciences of Nature*. Tehran: Islamic Propagation Organization. J ujun S. Suriasumantri, 2012. *Ilmu dalam Perspektif.* Jakarta: Yayasan Pustaka Obor Indonesia. O'hear, Anthony. 1989. *Introduction to the Philosophy of Science*. New York: Oxford. Osman Bakar. 1992. *Classification of Knowledge in Islam*. Kuala Lumpur: Institute for Policy Research. Soelaiman, A. Darwis. 2019. *Filsafat Ilmu Pengetahuan Perspektif Barat dan Islam*. Aceh: Bandar Publishing. Tim Dosen Filsafat Ilmu. 2001. *Filsafat Ilmu: Sebagai Dasar Pengembangan Ilmu Pengetahuan.* Yogjakarta: Liberty Yogyakarta.

LASERS AND BIOOPTICS (22060411F37)

Module designation	Lasers and Biooptics
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Dr. M. Tirono M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-751 Students are able to analyze the components of a laser generator. CO-752 Students are able to formulate alternative solutions in technologies and sciences related to light and matter. CO-753 Students are able to develop studies on the mechanisms of laser light interaction. CO-754 Students are able to disseminate knowledge on medical lasers.
Content	1. Gas Atomic Laser 2. Molecular Gas Laser 3. Laser Organic Dye 4. Solid State Laser 5. Gas and NdYAG Lasers 6. Semiconductor Diode Laser, 7. Reflection and Refraction; 8. Absorption, 9. Scattering, 10. Turbid Media 11. Photochemical Interaction 12. Thermal Interaction 13. Photoablation; 14. Plasma-Induced Ablation, 15. Photodisruption, 16. Lasers in Ophthalmology, 17. Lasers in Dentistry 18. Lasers in Gynecology 19. Lasers in Urology, 20. Lasers in Neurosurgery 21. Lasers in Angioplasty and Cardiology, 22. Lasers in Dermatology, 23. Lasers in Orthopedics, 24. Lasers in Gastroenterology 25. Lasers in Otorhinolaryngology and Pulmology
Examination forms	Paper Based Test

Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Silfvas, W.T., 2004, Fundamentals Lasers, Cambridge Ubiversity Press Additional : 1. Niemz, M.H., 1996, Laser-Tissue Interactions Fundamentals and Applications, Springer

MEDICAL INSTRUMENTATION (22060411F38)

Module designation	Medical Instrumentation
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Dr. H. Agus Mulyono S. Pd, M. Kes.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Cooperative learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-921 Students are able to analyze the classification, maintenance, sterilization, and calibration of medical devices. CO-922 Students are able to formulate the concept of cardiac electrophysiology and EKG, cardiac defibrillation and pacemaker implantation, as well as the use of ultrasound for therapy and diagnostics in medical practice. CO-923 Students are able to apply the concepts of radiophysics, as well as techniques such as electromyography (EMG), electroencephalography (EEG), and electroneurography (ENG) in medical practice. CO-924 Students are able to disseminate hyperbaric oxygen therapy and the use of electrosurgical units in medical practice.
Content	1. Classification of medical devices 2. Care and sterilization of medical equipment 3. Calibration of medical equipment 4. Cardiac electrophysiology and ECG 5. Heart defibrillation and pace maker 6. Tensiometer 7. Use of Ultrasound as therapy and diagnostics 8. Radiophysics 9. EMG, EEG and ENG 10. Hyperbaric Oxygen Therapy 11. Electrosurgical Unit
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Neuman, MR. 2004. Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation. New York. CRC Press Additional : 1. Webster, JG. 2010. Medical Instrumentation : Application and Design. 4th edition. John Wiley and Sons, inc 2. Valentinuzzi, ME. 2004. Understanding the Human Machine : A Primer for Bioengineering. New Jersey. World Scientific 3. Davidovits, P. 2008. Physics in Biology and Medicine. 3rd ed. USA. Elsevier inc. 4. Gabriel,dr. JF. 1996. Fisika Kedokteran. Fakultas Kedokteran FK Unud.

IMAGING PHYSICS (22060411F39)

Module designation	Imaging physics
Semester(s) in which the module is taught	7^{th} Semester
Person responsible for the module	Dr. H. Agus Mulyono S. Pd, M. Kes.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-931 Students are able to apply physical phenomena and problems related to Image Acquisition technology and image processing. CO-932 Students are able to analyze the potential application of image histogram problems, image quality enhancement techniques, and image segmentation. CO-933 Students are able to develop physical modeling techniques for feature extraction, morphology, and image compression techniques. CO-934 Students are able to formulate alternative solutions in Steganography and Watermarking techniques. CO-935 Students are able to disseminate the potential applications of Pattern Recognition and Machine Learning.
Content	1. Introduction and Image Acquisition 2. Introduction to Image Processing 3. Introduction to MATLAB 4. Image Histogram 5. Image Quality Improvement 6. Image Segmentation 7. Image Feature Extraction 8. Image Morphology 9. Image Compression 10. Steganography and Watermarking 11. Introduction to Pattern Recognition and Machine Learning
Examination forms	Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. Wijaya, MC dan Prijono, agus. 2007. Pengolahan Citra Digital Menggunakan Matlab. Penerbit Informatika :Bandung Additional : 1. Solomon, C and Breckon, T, 2012. "Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab " John Willey and Son " 2012. 2. Blanchet, Gerard., Charbit, Maurice. (2014). Digital Signal and Image Processing using MATLAB®. London: ISTE. 3. Utama, MM., Sasmitaning Hidayah, W. 2020. Pengaruh variasi sudut datang dan sudut tangkap cahaya pada nilai kontras citra spekel beras berbasis GUI Matlab. Jurnal Komunikasi Fisika Indonesia

BIOMAGNETICS (22060411F40)

Module designation	Biomagnetics
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Dr. Mokhammad Tirono, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-401 Student are able to master knowledge about biomagnetics and its applications CO-402 Student are able to analyze alternative solutions in technology and the scientific field of biophysics CO-403 Student are able to predict the potential application of physical behavior according to the scientific field of biophysics
Content	1. Introduction to biomagnetics 2. Principles of biomagnetic stimulation 3. Application of biomagnetic stimulation for medical treatment and research on the brain 4. Biomagnetic measurements 5. Principles of magnetic resonance imaging 6. Magnetic resonance imaging prospects of impedance and electric current 7. Magnetic control of biological cell growth 8. Effect of radio frequency magnetic fields on the release and uptake of iron from and to the protein cage 9. Safety aspects of magnetic fields and electromagnetic fields 10. New horizons in biomagnetics and bioimaging
Examination forms	Paper Based Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Shoogo Veno, Masaki Sekino. Biomagnetics: Principle and applications of Biomagnetic Stimulation and Imaging. CRC Press, 2016 Additional : 1. Samuel J. Williamson, Gian-Luca Romani, Lioyd Kaufman. Biomagnetism: An interdisiplinary approach. Springer Science & Business Media, 1983

INTRODUCTION TO MATERIAL PHYSICS (22060411F41)

Module designation	Introduction to Material Physics
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Dr. Erna Hastuti, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-951 Students are able to analyze concepts in materials science, various types of materials, and their physical and chemical properties in relevant problems. CO-952 Students are able to formulate concepts of physical and chemical properties of materials in relevant problems. CO-953 Students are able to develop concepts of techniques for identifying and characterizing material properties in relevant problems. CO-954 Students are able to disseminate the potential applications of materials in technological advancements.
Content	1. Introduction to materials science 2. Types of materials (ceramic, polymer, metal) 3. Atomic structure, bonds between atoms and interactions between molecules 4. Crystal structure and microstructure 5. Physical and chemical reactions 6. Phase changes and simple phase diagrams 7. Physical and chemical properties of materials 8. Crystal and diffusion defects in materials 9. Composites and material applications in everyday life 10. Techniques for identification and characterization of material properties 11. Equipment used to carry out testing 12. Development and application technology of materials
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main: 1. William Calliester, Materials Science and Engineering, John Wiley & Sons Inc, 2. LH Van Vlack, Elements of Material Science and Engineering Additional: International Journal Articles

COMPOSITE MATERIALS (22060411F42)

Module designation	Composite Materials
Semester(s) in which the module is taught	5th Semester
Person responsible for the module	Utiya Hikmah, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite:
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-961 Students are able to apply concepts of composite materials. CO-962 Students are able to formulate physical problems related to the properties, characteristics, and elastic modulus of composite materials. CO-963 Students are able to analyze alternative solutions for composite material fabrication. CO-964 Students are able to disseminate the potential applications of composite material fabrication.
Content	1. Definition of composite: matrix, fiber 2. Classification of composite materials: PMC, CMC, MMC 3. Properties and characteristics of composite materials: mechanical and electrical properties 4. Composite elastic modulus 5. Fabrication of composite materials: powder metallurgy, pultrusion, sol-gel etc 6. Create an experimental plan/module for making composite materials 7. Characterization of experimental results for making composite materials: tensile test
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main : 1. William D Callister, Introduction Material Science and Engineering, John Wiley & Sons; K.K Chawla, Composite Materials : Science and Engineering, Springer-Verlag, 1998 Additional: 1. Autar K.KAW. Mechanics of Composite Materials. Taylor & Francis, 2006 2. Donald F. Adams et al. Experimental Characterization of Advanced Composite Materials. CRC Press, 2002 3. Ayse Gul Yavuz, Aysegul Uygun, Venkat R. Bhethanabotla. Substituted polyaniline/chitosan composites: Synthesis and characterization. Carbohydrate Polymers 75 (2009) 448-453 4. Munasir, A S Dewanto, A Yulianingsih, I K F Saadah, Z A I Supardi, A Mufid and A Taufiq. Composites of Fe3O4/SiO2 from natural material synthesized by Co-Precipitation Method. IOP Conf. Series: Materials Science and Engineering 202 (2017) 012057 5. K.L. Pickering, M.G. Aruan Effendy, T.M. Le. A review of recent developments in natural fibre composites and their mechanical performance. Composites: Part A 83 (2016) 98-112

MATERIAL PROCESSING (22060411F43)

Module designation	Material Processing
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Utiya Hikmah, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-971 Students are able to analyze materials using bottom-up and top-down approaches, basic principles, substrate preparation, and solutions in thin film fabrication. CO-972 Students are able to formulate physical problems related to the sol-gel method. CO-973 Students are able to organize results of thin film formation, including spin coating, dip coating, and spray coating. CO-974 Students are able to disseminate the potential applications of material synthesis methods and present the results.
Content	1. Material synthesis using bottom-up and top-down approaches 2. Basic principles of chemical solution deposition 3. Substrate surface preparation 4. Initial solutions and reagents 5. Preparation of precursor solution: sol-gel process 6. Thin film formation properties: 7. spin coating 8. Dip coating 9. Spray coating 10. Characterization of nanomaterials
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. David B. Mitzi, Solution Processing of Inorganic Materials, John Wiley & Sons Inc, 2009 Additional: 1. William D Callister, Introduction Material Science and Engineering, John Wiley & Sons; K.K Chawla, Composite Materials : Science and Engineering, Springer-Verlag, 1998

MATERIAL CHARACTERIZATION (22060411F44)

Module designation	Material Characterization
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Dr. Erna Hastuti, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-981 Students are able to analyze materials and characterize mechanical and electrical properties in material technology. CO-982 Students are able to formulate characterization of magnetic properties, spectroscopy, and microscopy in material technology. CO-983 Students are able to organize problems in the material characterization process. CO-984 Students are able to disseminate material characterization results.
Content	1. Process of preparing materials according to testing, 2. Characterization of mechanical properties (Tensile, compression, elasticity, hardness), 3. Characterization of electrical properties (conductivity, impedance, permittivity, capacitance), 4. Characterization of magnetic properties (magnetic field, remanence, hysteresis curve) 5. Interaction of electromagnetic waves and materials 6. Spectroscopy and its classification 7. Microscopy
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Elton N. Kaufmann, Characterization of Materials Volume 1 & 2, Schaffer, et. Al 2. Richard Brundle, EncyCOpedia Of Materials Characterization, Reed Publishing USA Inc Additional: 1. Callister, Jr., W.D., Material Science and Engineering: an Introduction , John Wiley and

	Sons Inc., New York

ADVANCED MATERIALS (22060411F45)

Module designation	Advanced Materials
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Fikriyatul Azizah Su'ud, M.Si
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-991 Students are able to apply concepts of advanced materials to relevant problems. CO-992 Students are able to analyze physical modeling of the mechanical properties of materials, failure, and strengthening mechanisms (metals, ceramics, polymers) according to hypotheses in technology and the field of physics. CO-993 Students are able to formulate physical phenomena related to phase diagrams, phase transformations, CCT and TTT diagrams, and heat treatment in materials (metals, ceramics, polymers). CO-994 Students are able to organize knowledge of the physical phenomena, fabrication techniques, and characterization of nanomaterials. CO-995 Students are able to disseminate the potential applications of physical behaviors in the development of nanomaterials.
Content	1. Advanced materials and their descriptions 2. Mechanical properties of materials, failure and strengthening mechanisms of materials (metals, ceramics, polymers) 3. Phase diagrams, phase transformations, CCT and TTT diagrams and heat treatment of materials (metals, ceramics, polymers) 4. Nanostructured materials (nanomaterials). 5. Nanomaterials fabrication techniques. 6. Development of nanomaterials and their applications. 7. Characterization of nanomaterials.
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main: 1. Dieter, G. E.,Mechanical Metallurgy, McGraw-Hill BookCompany, London, 1988 2. Nanostructures and Nanomaterials: Synthesis, Properties, and Applications” (2 Edition) (World Scientific Series in Nanoscience and Nanotechnology) by Guozhong Cao and Ying Wang (Imperial College Press) Additional: 1. Callister, W. D Jr., Material Science And Engineering, An Introduction, SaltLake City, Utah, 1985 2. M. Kohler, W. Fritzsche, 2004, Nanotechnology : An Introduction to Nanostructruring Techniques, John Wiley& Sons 3. M.J.d. Andrade, 2011 Nanostructrured Materials for Engineering Applications, Springer, Berlin 4. J. Ramsden, 2009, Essentials of Nanotechnology, Jeremy Ramsden & Ventus Publishing ApS

ELECTRONIC MATERIALS (22060411F46)

Module designation	Electronic Materials
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Fikriyatul Azizah Su'ud, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-1001 Students are able to understand knowledge about semiconductor materials, basic crystal structure, valence bonds, and energy bands in material technology. CO-1002 Students are able to analyze alternative solutions regarding charge carrier concentration, donor, acceptor, Fermi level, and their applications in material technology. CO-1003 Students are able to develop alternative solutions concerning charge carrier mobility, continuity equations, generation, and recombination in material technology. CO-1004 Students are able to disseminate the characteristics of semiconductor materials.
Content	1. Semiconductor Materials. 2. Basic Crystal Structure. 3. Valence Bonds. 4. Energy Band. 5. Intrinsic Carrier Concentration. 6. Donors and Acceptors. 7. Fermi level. 8. Drift Carrier Current. 9. Diffusion Carrier Current 10. Generation and Recombination. 11. Continuity Equation. 12. Thermionic Emission Process. 13. Breakthrough Process. 14. High Field Effect.
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main: 1. Callister, W. D Jr., Material Science And Engineering, An Introduction, SaltLake City, Utah, 1985 Additional: 1. Giancoli, D. C., 2001. *Fisika.* 5th ed. Jakarta: Erlangga. 2. Noer , Z. & Dayana , I., 2021. *Buku Fisika dan Teknologi Semikonduktor.* Medan: Guepedia. 3. Sutikno, 2010. *Pengantar Fisika dan Teknologi Semikonduktor.* 1st ed. Yogyakarta: Deepublish.

CRYSTAL DIFFRACTION (22060411F47)

Module designation	Crystal Diffraction
Semester(s) in which the module is taught	7th Semester
Person responsible for the module	Utiya Hikmah, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-1011 Students are able to analyze the concept of crystal diffraction. CO-1012 Students are able to formulate physical problems related to diffraction and Bragg's Law. CO-1013 Students are able to develop alternative solutions to determine crystal size, crystal structure, and master crystal geometry. CO-1014 Students are able to predict the potential application of the Rietveld method in XRD test results.
Content	1. Definition and properties of X-rays, history of the invention of the X-ray diffractometer 2. How the X-ray diffractometer works, X-ray diffraction on samples 3. Crystal geometry: crystal structure 4. Crystallographic Points, Directions, and Planes 5. Crystal systems and space groups 6. Sample characterization using XRD 7. Plot the XRD test data using origin 8. Identify the phase of the XRD data 9. Data analysis using the Rietvield method 10. Refinement of XRD results using Rietica 11. Calculate the crystalline size of the sample based on XRD results using origin
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main: 1. Cullity BD, Element of X-Ray Diffraction, Addison-Wesley Publ Co, Inc, 1978 Additional: 1. Bob B. He, Two-Dimensional X-Ray Diffraction, John Wiley & Sons, 2009; Young RA, The Rietveld Method, UlCr Oxford University Press, 1993 2. Ferry Iskandar, Utiya Hikmah, Erythrina Stavila and Akfiny H. Aimon, Microwave assisted reduction method under nitrogen atmosphere for synthesis and electrical conductivity improvement of reduced graphene oxide (rGO), RSC Advances (2017) 3. Utiya Hikmah, Erythrina Stavila, Dadang Suhendra, Akfiny H. Aimon, Ferry Iskandar, The efeect of microwave duty cycle on the electrical conductivity of reduced graphene oxide (rGO). IOP Conf. Series: Journal of Physics: Conf. Series 1204 (2019) 012076

MATERIALS EXPERIMENT (22060411F48)

Module designation	Materials Experiment
Semester(s) in which the module is taught	7st Semester
Person responsible for the module	Dr. Erna Hastuti, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-1021 Students are able to organize experimental activities independently CO-1022 Students are able to apply theoretical concepts in the synthesis process and formulate problems in material experiments. CO-1023 Students are able to analyze theoretical concepts and knowledge to interpret experimental data. CO-1024 Students are able to disseminate experimental results through an experimental report.
Content	Determining the material to be made, objectives, manufacturing process, characterization, analysis of results, making reports and presenting experimental results
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main: 1. Journals and other sources used as references in the manufacturing process and material characterization. Additional: 1. Callister, W. D Jr., Material Science And Engineering, An Introduction, SaltLake City, Utah, 1985

CAPITA SELECTA IN MATERIAL PHYSICS (22060411F49)

Module designation	Capita Selecta in Material Physics
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Naqiibatin Nadliriyah, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50" x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-1031 Students are able to analyze the development of material physics technology. CO-1032 Students are able to apply the results of scientific studies on research developments in the field of materials in both oral and written communication. CO-1033 Students are able to formulate physical phenomena and material issues from nature and biodegradable polymers. CO-1034 Students are able to disseminate alternative solutions in superconductor technology and corrosion inhibitors.
Content	1. Development of research in the field of materials 2. Materials from nature 3. Biodegradable Polymer 4. Superconductors 5. Corrosion inhibitor
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort
Reading list	Main : 1. Kittel, Introduction to solid state physics, John Willey and Sons, New York, 8th ed. 2005 Additional: 1. Jurnal material science terbaru

COMPUTATIONAL OF MATERIAL PHYSICS (22060411F50)

Module designation	Computational of Material Physics
Semester(s) in which the module is taught	6th Semester
Person responsible for the module	Dr. Erna Hastuti, M.Si.
Language	Indonesian
Relation to curriculum	Elective Courses for undergraduate program in Bachelor of Physics
Teaching methods	Project Based Learning 2 x 50” x 16 week per Semester
Workload (incl. contact hours, self-study hours)	1. Lectures : 2 x 50 = 100 minutes per week. 2. Exercises and Assignments : 2 x 60 = 120 minutes (2 hours) per week. 3. Private learning : 2 x 60 = 120 minutes (2 hours) per week.
Credit points	2 SKS ~ 2.94 ECTS
Required and recommended prerequisites for joining the module	Each student must attend at least 75% of the lectures to be able to take the exam Course Prerequisite: -
Module objectives/intended learning outcomes	PLO-05 Able to analyze theoretical concepts of classical and modern physics, mathematical methods, and knowledge of technology in relevant problems.[P] PLO-07 Students are able to describe physical phenomena and issues, evaluate potential solutions, and use physical modelling that complies with physics and technology-related theories. PLO-08 Students are able to predict the potential application of physical phenomena and disseminate the results of scientific studies in oral and written communication according to the scientific field of physics.

CO	CO-1041 Students are able to apply basic concepts of solid-state materials along with material properties. CO-1042 Students are able to analyze material physics problems based on the principles and basic concepts of computation. CO-1043 Students are able to formulate physical modeling solutions through computer assistance and appropriate software usage. CO-1044 Students are able to disseminate the application of physical behaviors using various forms of visualization, graphics, or simulations and modeling according to the structure and properties of materials.
Content	1. Basics of Solids: Bonding in Solids, Crystal Structure of Solids, Electronic Structure of Solids 2. Introduction to Computational Physics 3. Principles and Functions of Computational Physics 4. Numerical Calculations in Computers 5. Simulation Program and Modeling Program 6. Introduction to Software in Materials Computing 7. Modeling Electron Motion 8. Analysis of Simulation and Modeling Programs 9. Application of Computational Physics in Modeling and Simulation
Examination forms	Paper Based Test, Oral Presentation Test
Study and examination requirements	**Cognitive**: Midterm exam, Final exam, Quizzes, Assignments **Psychomotor**: Practice **Affective**: Assessed from the element /variables achievement, namely (a) Contributions (attendance, active, role, initiative, language), (b) Being on time, (c) Effort

Reading list	Main: 1. Richard LeSar, 2013, Introduction Computational Materials Science, Fundamentals to Applications, Cambridge University Press, Cambridge, UK Works : 1. June Gunn Lee, 2012, Computational M, an Introduction, CRC Press, Taylor & Francis Group, Boca Raton, USA Dierk Raabe, 1998, Computational Materials Science, Wiley-VCH, New York, USA. 2. Hand-out perkuliahan (ppt, pdf lectures, dll).