CURRICULUM DOCUMENT

Physics Study Program
Faculty of Mathematics and Natural Sciences
University of Mataram

2023

CURRICULUM DOCUMENT

DEPARTMENT OF PHYSICS

DEPARTMENT OF PHYSICS
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITY OF MATARAM

DOCUMENT

Higher Education Curriculum Development

Physics Study Program

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DEPARTMENT OF PHYSICS
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS MATARAM

Authorization

The Curriculum Document of the Physics Study Program, Faculty of Mathematics and Natural Sciences, University of Mataram has been checked for its suitability for approval.

Process	Responsible Person			Date
	Name	Position	Signature	
Formulator	Dr. Rahadi Wirawan, S.Si., M.Si.	Head of Curriculum Document Drafting Team	**signed**	**12/04/2021**
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Control	Dr. Drs. Mazuki, M.Si.	Head of the Faculty Quality Assurance Group (GPM)	**signed**	**07/26/2023**

Halaman Pengesahan

Dokumen Kurikulum Program Studi Fisika Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Mataram telah diperiksa kelayakannya untuk disahkan.

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PREFACE

In order to achieve educational objectives, especially in the study program, the curriculum serves as a vital tool that provides a guideline for learning activities conducted within the study program. Curriculum changes are routine activities that must be carried out in response to the developments in science and technology (IPTEKS), societal needs, and the requirements of graduates' users (stakeholders). The curriculum must facilitate students' learning, enabling them to recognize their roles and functions, directing them to think critically, with a high level of reasoning (higher-order thinking).

We express our gratitude and praise to Allah SWT, the Almighty, for His abundant blessings and grace, allowing the completion of the Curriculum Document for the Bachelor (S1) Degree in Physics at the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Mataram. This document will serve as a guide for the Physics Study Program in implementing learning activities aimed at improving and developing the quality of education for Physics graduates.

The curriculum document has been developed through a long process and valuable input from various parties for its refinement. On this occasion, we extend our heartfelt thanks and high appreciation to the Curriculum Document Development Team for the Physics Study Program, FMIPA Universitas Mataram, for all their efforts. We also extend our gratitude to the Physics lecturers, the leadership of the Faculty of Mathematics and Natural Sciences at Universitas Mataram, and the Quality Assurance and Educational Development Institute (LPMPP) of Universitas Mataram for their contributions and guidance during the preparation of this curriculum document.

Mataram, October 26, 2022
Head of Physics Study Program
FMIPA Universitas Mataram

Dr. Rahadi Wirawan, S.Si., M.Si.

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IDENTITY OF STUDY PROGRAM

1.	Name of University (PT)	UNIVERSITY OF MATARAM
2.	Faculty	MATHEMATIS AND NATURAL SCIENCES
3.	Department	-
4.	Study Program	PHYSICS
5.	Education Level	BACHELOR
6.	Graduate Degree	S.Si.
7.	Study Program Characteristics	Application of Physics science and technology development for the archipelago
8.	Study Program Vision	Becoming a Study Program in the field of Physics based on research on local natural resources with international competitiveness in 2025
9.	Study Program Mission	1. Carrying out physics learning activities based on research on local natural resources that are competitive and of high quality in producing human resources with a global perspective based on faith and piety. 2. Carrying out physics research activities based on research on local natural resources that are able to produce science and technology with international competitiveness, supporting learning activities and community service. 3. Carrying out community service activities based on research on local natural resources in order to build a sustainable culture, social and economic community. 4. Building cooperation with various parties/institutions at home and abroad to support the implementation of the Tri Dharma of Higher Education. 5. Carrying out efficient, effective and transparent education administration to support the implementation of the Tri Dharma of Higher Education.
10.	Institution address	FMIPA, Jl. Majapahit No. 62 Mataram, West Nusa Tenggara, Postal Code 83125.
11.	Institution Telephone number	(0370) 646506
12.	URL Address	http://fisika.unram.ac.id; email: fisika.mipa@unram.ac.id

1. INTRODUCTION

1.1 Background

The Physics Study Program is one of the study programs within the Faculty of Mathematics and Natural Sciences (FMIPA) at the University of Mataram. The establishment of the Physics Study Program is part of an effort to strengthen the Basic Sciences at the University of Mataram. The establishment of this program was based on the Decree of the Director General of Higher Education, Ministry of National Education of the Republic of Indonesia No. 1192/DT/2006 dated April 12, 2006, for the implementation of the Bachelor (S-1 Regular) Program in Physics.

The curriculum serves as a vital tool that provides guidelines for the execution of learning activities within the Physics Study Program. Curriculum revisions are a routine activity that must be carried out in response to advancements in science and technology, societal needs, and the requirements of graduates' stakeholders. The curriculum developed must facilitate students' learning so they can become aware of their roles and functions, guiding them to think critically, with a high level of reasoning (higher-order thinking). Graduates of the study program must possess competencies in data literacy, technology literacy (coding, artificial intelligence, and engineering principles), and human literacy, which includes understanding the humanities, communication, and design.

Furthermore, the policy of the Minister of Education and Culture through the Ministerial Regulation No. 3 of 2020, which mandates that higher education institutions must facilitate the right of students to study outside their Study Program or Higher Education Institution, implemented through eight forms of learning activities under the Merdeka Belajar-Kampus Merdeka (MBKM) program, is also a reason for the reconstruction of the curriculum of the Physics Study Program at the Faculty of Mathematics and Natural Sciences, University of Mataram.

1.2 Objectives

The objectives of the curriculum reconstruction are:

a. To establish the educational objectives of the Physics Study Program at the Faculty of Mathematics and Natural Sciences (FMIPA), University of Mataram.
b. To define the Program Learning Outcomes (PLO) for graduates of the Physics Study Program at FMIPA, University of Mataram.
c. To develop the curriculum for the Physics Study Program at FMIPA, University of Mataram.

2. Curriculum Evaluation and Tracer Study

2.1 Curriculum Evaluation

The evaluation of curriculum implementation is aimed at determining whether the current curriculum (2016 Curriculum) has successfully achieved its intended goals, specifically in providing direction and guidance for the study program in the delivery of education. The expected learning outcomes include producing graduates with competencies in Physics that

meet the desired standards within the specified study duration, graduates who can be absorbed into and adapt to the workforce, or those capable of creating employment opportunities. The evaluation also seeks to assess the effectiveness and efficiency of the study program in executing the curriculum's programs. The curriculum evaluation is conducted by the Quality Assurance Unit (Gugus Penjamin Mutu) of the Faculty of Mathematics and Natural Sciences.

The 2016 Physics Study Program curriculum prepares graduates with competencies in theoretical, experimental, and computational aspects. The Physics curriculum provides students with opportunities to gain knowledge and experience in the professional world through internship courses, offers flexibility in conducting final project research at research institutions, and equips students with entrepreneurial skills. The 2016 curriculum has successfully produced graduates working in various fields such as education, laboratory work, telecommunications companies, mining, geophysical practice, medical physics, as well as entrepreneurship, and has enabled graduates to pursue further education at higher levels.

Government policies related to higher education learning require universities to provide students with learning experiences outside their study programs through the Merdeka Belajar Kampus Merdeka (MBKM) program. Additionally, the current era of Industry 4.0 necessitates competencies in data literacy, technology literacy, and human literacy, along with skills that foster High Order Thinking Skills (HOTS), prompting the study program to review or reconstruct the existing curriculum structure. The MBKM program encourages study programs to establish and develop collaborations with institutions and industries. The resulting curriculum can support the realization of the study program's vision and mission and produce graduates with recognized competencies that align with the demands of the workforce and a high capacity to adapt in this era of Society 5.0.

2.2 Tracer Study

Needs analysis was conducted through surveys of alumni. The survey included questions about the relevance of the knowledge they acquired during their education at the University of Mataram. The survey results were then analyzed to map out the most needed graduate profiles in various professions.

Needs analysis was also carried out through a Focus Group Discussion (FGD), involving various stakeholders such as government officials, alumni, alumni employers, professional organizations, and leaders within the University of Mataram. The FGD was held on January 18, 2021, with the goal of obtaining various inputs related to the optimal curriculum structure to ensure that graduates have profiles that meet the needs of the professional world and other areas. Some of the considerations included the MBKM program policy, curriculum design oriented towards international standards, the development of learning to strengthen alumni's physics competencies to support the continuation of studies at higher levels, alumni with the competencies and skills required in the era of Industry 4.0 who are capable of adapting to the workforce, and the curriculum providing space for disaster studies and disaster mitigation from a physics perspective, given that the province of West Nusa Tenggara (NTB) can be categorized as a disaster-prone area.

3. Foundation for Curriculum Development

3.1 Philosophical Foundation

Science and technology continue to evolve alongside the progression of time, and Physics plays a crucial role within this advancement. Physics is one of the fundamental sciences (basic science) that serves as the foundation for the development of both science and technology. In physics education, students learn how to address physics-related problems and formulate appropriate solutions using mathematics. They learn how to plan, conduct, and report the results of experiments or investigations, and how to critically compare outcomes with theoretical predictions.

The curriculum of the Physics Study Program must facilitate students in mastering the theories and concepts within the field of physics and their applications, mastering and applying mathematics to help describe, analyze, and solve physics problems, and providing experiences to conduct experiments or investigations to understand natural phenomena. It should enable students to find appropriate solutions to physics problems and support the development of science and technology grounded in scientific ethics. The curriculum also provides students with the experience of applying their thoughts, knowledge, and skills for societal development. These aspects are implementations of the educational pillars proposed by UNESCO in facing globalization and the Industry 4.0 era, namely *learning to know, learning to do, learning to be, and learning to live together.*

3.2 Sociological Foundation

The curriculum developed by the study program must be able to adapt to the developments and demands of the times, especially as we enter the era of Industry 4.0 and Society 5.0, where humans and technology will coexist to sustainably enhance the quality of human life. Competencies required in the Industry 4.0 era include data literacy, technology literacy (coding, artificial intelligence, and engineering principles), and human literacy, along with skills that foster high-order thinking skills such as Communication, Collaboration, Critical thinking, Creative thinking, Computational logic, Compassion, and Civic responsibility. Additionally, graduates are also expected to have a high ability to adapt to changes.

Curriculum reconstruction is carried out to reformulate the learning objectives set out in the previous curriculum to meet the needs of the workforce and industry regarding the competencies that graduates must possess.

3.3 Psychological Foundation

A curriculum is a set of plans and arrangements regarding objectives, content, teaching materials, and methods used as guidelines for organizing learning activities to achieve higher education goals (Ministerial Regulation No. 3 of 2020 on National Standards for Higher Education). The curriculum serves as both a program and a tool to achieve educational goals related to the process of behavioral change in students as learners. The curriculum should be able to stimulate students' curiosity and motivate lifelong learning, facilitate students in realizing their roles and functions in their environment, encourage critical thinking with a

high level of reasoning (higher-order thinking), and optimize the development of students' potential to become the desired individuals (Zais, 1976, p. 200).

The Physics Study Program curriculum at the University of Mataram includes learning outcomes that encompass knowledge, values/attitudes, and skills that reflect a holistic individual, both physically and spiritually. The emphasized changes in attitude/values include piety to God Almighty, upholding human values, contributing to community life, possessing social sensitivity, responsibility, and an independent spirit, love of the homeland, law-abidingness, and discipline. Moreover, the curriculum developed facilitates learning for elective fields that students wish to study in addition to the mandatory courses that must be completed. The learning strategies applied should be capable of realizing the expected learning outcomes. The evaluation of learning activities is aimed at assessing the achievement of learning objectives and is carried out in a structured manner with measurable output targets.

3.4 Historical Foundation

Curriculum development is carried out to provide a reference in the development of learning that is conducted to achieve high-quality learning activities with clear standards and measurable output targets. Since the establishment of the Physics Study Program at FMIPA, University of Mataram in 2006, the program has implemented four curricula: the 2006 curriculum, the 2011 curriculum, the 2012 curriculum, and the 2016 curriculum. Continuous curriculum evaluation and reconstruction are conducted to realize the established vision and mission, as well as to meet the evolving needs of graduates, ensuring that the Physics Study Program produces graduates with strong scientific competencies and high adaptability to the changing demands of the workforce. In 2021, the Physics Study Program undertook curriculum reconstruction to enhance the quality of its graduates and to address the competencies required in the Industry 4.0 and Society 5.0 eras. The learning experiences gained by graduates are not only derived from the study program itself but also include opportunities to gain learning experiences outside the study program and outside the university.

3.5 Legal Foundation

The issuance of Ministerial Regulation No. 3 of 2020 on National Standards for Higher Education (SN-Dikti) prompted study programs in higher education institutions to review their curricula. However, curriculum development in higher education institutions remains based on the Indonesian National Qualifications Framework (Perpres No. 8 of 2012), which regulates the equivalence and levels of educational programs. The standards for study program implementation are detailed according to their levels in SN-Dikti. These standards include graduate competence standards, content standards, process standards, and evaluation standards, as outlined in SN-Dikti, including Attitude Learning Outcomes (PLO Sikap) and General Skills Learning Outcomes (PLO Keterampilan Umum).

In detail, the legal foundation for the design and development of the curriculum is based on several relevant regulations, as follows:

a. Law Number 20 of 2003 on the National Education System.

b. Law of the Republic of Indonesia Number 14 of 2005 on Teachers and Lecturers (State Gazette of the Republic of Indonesia Year 2005 Number 157, Supplement to the State Gazette of the Republic of Indonesia Number 4586).
c. Law of the Republic of Indonesia Number 14 of 2005 on Teachers and Lecturers (State Gazette of the Republic of Indonesia Year 2005 Number 157, Supplement to the State Gazette of the Republic of Indonesia Number 4586).
d. Law Number 12 of 2012 on Higher Education.
   Article 35 of the Curriculum, paragraph (3), states that the Higher Education Curriculum as referred to in paragraph (1) must include courses on Religion, Pancasila, Citizenship, and the Indonesian Language.
e. Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 49 of 2014 on National Standards for Higher Education.
f. Presidential Regulation of the Republic of Indonesia Number 8 of 2012 on the Indonesian National Qualifications Framework (KKNI).
g. Ministerial Regulation Number 3 of 2020 on National Standards for Higher Education, Part Two on Graduate Competency Standards.
   Article 5:
   (1) Graduate competency standards are the minimum criteria regarding the qualifications of graduates, encompassing attitudes, knowledge, and skills as stated in the learning outcomes.
   (2) The graduate competency standards expressed in the learning outcomes as referred to in paragraph (1) are used as the primary reference for the development of content standards, learning process standards, assessment standards, lecturer and educational staff standards, learning infrastructure standards, learning management standards, and learning financing standards.
   (3) The formulation of learning outcomes as referred to in paragraph (1) must:
      a. Refer to the learning outcomes described in the KKNI; and
      b. Be equivalent to the qualification levels in the KKNI.

   Article 6:
   (1) Attitudes as referred to in Article 5, paragraph (1), are behaviors that are ethical and cultured, resulting from the internalization and actualization of values and norms reflected in spiritual and social life through learning processes, work experiences, student research, and/or community service related to learning.
   (2) Knowledge as referred to in Article 5, paragraph (1), is the mastery of concepts, theories, methods, and/or philosophy of a specific field of knowledge systematically acquired through reasoning in the learning process, work experience, student research, and/or community service related to learning.
   (3) Skills as referred to in Article 5, paragraph (1), are the ability to perform tasks using concepts, theories, methods, materials, and/or instruments acquired through learning, work experience, student research, and/or community service related to learning, including:
      a. General skills as general work competencies that every graduate must possess to ensure equivalence of abilities according to the level of program and type of higher education; and
      b. Specific skills as special work competencies that every graduate must possess according to the field of study of the program.

(4) Student work experience as referred to in paragraphs (2) and (3) is in the form of activities in a specific field for a certain period, such as internships, work practices, fieldwork, or other similar activities.

Article 7:

(1) The formulation of attitudes and general skills as part of the learning outcomes as referred to in Article 6, paragraphs (1) and (3), for each program level and type of higher education, is stated in the Appendix, which is an integral part of this Ministerial Regulation.
(2) The formulation of attitudes and general skills as referred to in paragraph (1) may be supplemented by the higher education institution.
(3) The formulation of specific knowledge and skills as part of the learning outcomes as referred to in Article 6, paragraphs (1) and (3), must be developed by:
   a. A forum of similar study programs or another equivalent name; or
   b. The study program management if no forum of similar study programs exists.
(4) The formulation as referred to in paragraphs (2) and (3), which constitutes a unified formulation of learning outcomes, is proposed to the relevant director general according to their authority for approval as the learning outcomes.
(5) The formulation of learning outcomes as referred to in paragraph (4) is reviewed and approved by the Minister as a reference for similar study programs.
(6) Provisions regarding the development, submission, review, and approval of learning outcomes formulations as referred to in paragraph (5) are regulated by the Ministerial Regulation.

h. Ministerial Regulation Number 3 of 2020 on National Standards for Higher Education.

Article 15:

(1) Learning forms as referred to in Article 14, paragraph (5), can be conducted within the Study Program and outside the Study Program.
(2) Learning outside the Study Program as referred to in paragraph (1) consists of:
   a. Learning in another Study Program at the same Higher Education Institution;
   b. Learning in the same Study Program at a different Higher Education Institution;
   c. Learning in another Study Program at a different Higher Education Institution; and
   d. Learning in non-Higher Education Institutions.

Article 17:

(1) The duration and workload for educational programs:
   d. A maximum of seven (7) academic years for bachelor's programs, diploma four/applied bachelor's programs, with a minimum student workload of 144 credits (sks);

Article 18:

(1) The fulfillment of the duration and workload for students in bachelor's or applied bachelor's programs as referred to in Article 17, paragraph (1) letter d can be accomplished by:
   a. Following the entire learning process within the Study Program at the Higher Education Institution according to the duration and workload; or

b. Following the learning process within the Study Program to fulfill part of the duration and workload and the rest by participating in learning activities outside the Study Program as referred to in Article 15, paragraphs (1) and (2).

(2) Higher Education Institutions must facilitate the fulfillment of the duration and workload in the learning process as referred to in paragraph (1).

(3) Facilitation by Higher Education Institutions for the fulfillment of the duration and workload in the learning process as referred to in paragraph (1) letter b by:

a. At least four (4) semesters and a maximum of eleven (11) semesters are learning within the Study Program;
b. One (1) semester or equivalent to twenty (20) credits (sks) is learning outside the Study Program at the same Higher Education Institution; and
c. A maximum of two (2) semesters or equivalent to forty (40) credits (sks) are:
    1. Learning in the same Study Program at a different Higher Education Institution;
    2. Learning in a different Study Program at a different Higher Education Institution; and/or
    3. Learning outside Higher Education Institutions.

i. Ministerial Regulation Number 5 of 2020 on the Accreditation of Study Programs and Higher Education Institutions.
j. Ministerial Regulation Number 7 of 2020 on the Establishment, Amendment, Dissolution of State Universities, and the Establishment, Amendment, Revocation of Private University Licenses.
k. Ministerial Regulation Number 22 of 2020 on the Strategic Plan of the Ministry of Education and Culture.
l. Rector's Regulation Number 2 of 2020 on the Implementation of the MBKM Policy.
m. Rector's Regulation Number 3 of 2020 on the Academic Guidelines of the University of Mataram.
n. Rector's Regulation Number 7 of 2021 on the Amendment to the Rector's Regulation No. 3 of 2020 on the Academic Guidelines of the University of Mataram.
o. Rector's Decree Number 4476/UN.18/HK/2021 on the Determination of the Guidelines for the Recognition/Accreditation of Student Activities as University of Mataram Semester Credit Units.
p. Rector's Decree of the University of Mataram No. 10185/UN18/HK/2021 on the Determination of Curriculum Development Guidelines of the Quality Assurance and Educational Development Institute of the University of Mataram in 2021.
q. Dean’s Decree of FMIPA University of Mataram Number 131A/UN18.F8/HK/2021 on the Determination of Mandatory Courses at the Faculty of Mathematics and Natural Sciences, University of Mataram in 2021.

4. Vision, Mission, Objectives, Strategy, and University Values

4.1 Vision, Mission, Objectives, and Strategies of the University of Mataram

a. Vision of the University of Mataram

“To become a research-based higher education institution with international competitiveness by 2025”.

b. Mission of the University of Mataram

1. To implement a higher education process with national and international quality standards, grounded in strong research, to produce human resources who are faithful and pious to God Almighty, possess noble character, are competent in their fields, and have a global perspective.
2. To conduct research activities with national and international quality standards to generate scientific knowledge and technology that can enrich the body of knowledge and serve as a reference for solving societal problems, thereby supporting quality education for students and community service.
3. To carry out community service activities based on research, contributing to the resolution of various issues in society, promoting economic growth, and building the social and cultural fabric of Indonesian society.
4. To establish extensive collaboration networks with various parties, including government and private institutions, both domestically and internationally, to support the implementation of the threefold mission of higher education (Tri Dharma Perguruan Tinggi) at national and international quality standards.
5. To manage assets, finances, and administration in accordance with good university governance standards efficient, effective, transparent, and accountable—to support the implementation of the Tri Dharma of higher education at national and international quality standards.

c. Objectives of the University of Mataram

1. To produce graduates who are faithful and pious to God Almighty, possess noble character, have strong academic competence in their fields, and have a global perspective, enabling them to compete nationally and internationally in the era of globalization.
2. To generate research products in the form of scientific knowledge and technology that enrich the body of knowledge and can be used as references for solving various national, regional, and international problems.
3. To disseminate scientific knowledge and technology derived from research in the form of community service, contributing to the development of the economy, society, and culture of the Indonesian nation.
4. To establish broad collaborations with various parties, including government and private institutions, both domestically and internationally, to support the implementation of the Tri Dharma of higher education at national and international quality standards.
5. To build a system of asset, financial, and administrative management that adheres to good university governance standards—efficient, effective, transparent, and accountable—to support the implementation of the Tri Dharma of higher education at national and international quality standards.

d. Targets and Strategies of the University of Mataram

The University of Mataram has set the following targets to achieve its mission:

a. Targets

1. The establishment and implementation of a national and international quality

standard higher education system at Unram, grounded in strong research, capable of producing human resources who are faithful and pious to God Almighty, possess noble character, are competent in their fields, and have a global perspective.

2. The establishment and implementation of a national and international quality standard research system at Unram, capable of generating scientific knowledge and technology that enrich the body of knowledge, serve as a reference for solving societal problems, and support high-quality education and continuous community service.
3. The establishment and implementation of a community service system based on research results at Unram, enabling Unram to make significant contributions to solving various societal issues, promoting economic growth, and building the social and cultural fabric of Indonesian society.
4. The establishment of extensive collaboration networks with various parties, including government and private institutions, both domestically and internationally, capable of supporting the implementation of the Tri Dharma of higher education at national and international quality standards.
5. The establishment of an asset, financial, and administrative management system that adheres to good university governance standards—efficient, effective, transparent, and accountable—to support the implementation of the Tri Dharma of higher education at national and international quality standards.

b. Strategies

The strategic plan for the development of the University of Mataram has been described in the University of Mataram's Strategic Plan 2020-2024, which includes the "Five Pillars" of the university's strategic development:

1. Education Development Strategy
   - Curriculum Development Strategy
   - Faculty Competence Development Strategy
   - Education Laboratory Development Strategy
   - Co-curricular Development Strategy
2. Research Development Strategy
3. Community Service Development Strategy
4. Planning, Collaboration, and Information Systems Development Strategy
5. Governance Development Strategy

4.2 Vision, Mission, Objectives, and Strategies of the Faculty

a. Vision of the Faculty of Mathematics and Natural Sciences (FMIPA)

"*To become a higher education institution in the field of Mathematics and Natural Sciences based on local natural resource research with international competitiveness by 2025*".

b. Mission of the Faculty of Mathematics and Natural Sciences

1. To conduct educational activities in Mathematics and Natural Sciences based on competitive and quality local natural resource research to produce globally-minded human resources grounded in faith and piety.
2. To conduct research activities in Mathematics and Natural Sciences based on competitive local natural resource research, capable of producing internationally competitive science and technology, supporting educational activities, and community service.
3. To carry out community service activities in Mathematics and Natural Sciences based on local natural resource research, contributing to building sustainable cultural, social, and economic development in society.
4. To establish collaborations with various parties/institutions, both domestic and international, to support the implementation of the Tri Dharma of higher education.
5. To manage assets, finances, and administration efficiently, effectively, transparently, and accountably to support the implementation of the Tri Dharma of higher education.

c. Objectives of the Faculty of Mathematics and Natural Sciences

1. To produce graduates who are faithful and pious to God Almighty, possess noble character, are highly dedicated and innovative, have strong academic competence in their fields, and have a global perspective, enabling them to compete nationally and internationally in the era of globalization, while also being able to explore local natural resources and apply scientific knowledge to improve the quality of life in society.
2. To generate research products in the field of Mathematics and Natural Sciences that enrich the body of knowledge and can be used as references for solving various regional, national, and international problems.
3. To disseminate research findings in the form of community service, contributing to the development of the economy, society, and culture of the Indonesian nation.
4. To establish broad collaborations with various parties, including government and private institutions, both domestically and internationally, to support the implementation of the Tri Dharma of higher education at national and international quality standards.
5. To build an asset, financial, and administrative management system that adheres to good faculty governance standards—efficient, effective, transparent, and accountable—to support the implementation of the Tri Dharma of higher education at national and international quality standards.

d. Targets and Strategies of the Faculty of Mathematics and Natural Sciences

The Faculty of Mathematics and Natural Sciences has set the following targets and strategies to achieve its vision:

a. Targets

1. The establishment and implementation of an innovative higher education system at FMIPA University of Mataram that aligns with the competencies of Physics Study Program graduates and keeps pace with developments in science and technology based on local natural resources.
2. The establishment and implementation of internationally competitive research in

Physics at FMIPA University of Mataram that supports educational activities utilizing local natural resource potential.

3. The implementation of community service activities based on faculty research findings to build sustainable cultural, social, and economic development in society.
4. The establishment of active collaborations with government and private institutions, both domestically and internationally, to support the implementation of the Tri Dharma of higher education at quality standards.
5. The implementation of efficient, effective, and transparent online-based administrative services to support the implementation of the Tri Dharma of higher education.

b. Strategies

In achieving the vision of the Faculty of Mathematics and Natural Sciences, University of Mataram, the Faculty of Mathematics and Natural Sciences has established a strategy that is in line with the strategy of the University of Mataram, namely the development of the following five pillars:

1. Enhancing faculty competencies in their respective fields, improving the quality of education through strengthened content and computational skills, structured and systematic lesson planning, providing adequate learning infrastructure, and offering students the flexibility to engage in research and community service.
2. Increasing the number of research projects and faculty involvement in various research schemes with recognized and globally indexed scientific publications as outputs. Improving the quality and quantity of publications is also pursued through research and publication collaborations with colleagues within the faculty, the university, or other universities/institutions outside the university.
3. Expanding the number of activities and broadening the scope of community service, particularly in productive, remote, or disaster-prone areas.
4. Establishing collaborations with educational institutions to improve faculty qualifications, collaborative research, and teaching; with government or private institutions to enhance student learning competencies to support research and practical training, and with faculty collaboration research aimed at increasing the quality and quantity of publications.
5. Building a structured faculty and student administration system that supports the activities of the Tri Dharma of higher education.

4.3 Vision, Mission, Objectives, and Strategies of the Study Program

The vision of the Physics Study Program at FMIPA University of Mataram is derived from the vision established by FMIPA in the FMIPA Strategic Plan 2021-2025, which is also a derivative of the University of Mataram's vision as described in the University of Mataram Strategic Plan 2020-2024.

a. Vision of the Physics Study Program

"*To become a Physics Study Program based on local natural resource research with international competitiveness by 2025*".

b. Mission of the Physics Study Program

1. To conduct physics education activities based on competitive and quality local natural resource research to produce globally-minded human resources grounded in faith and piety.
2. To conduct physics research based on local natural resource research capable of producing internationally competitive science and technology, supporting educational activities and community service.
3. To carry out community service activities based on local natural resource research, contributing to sustainable cultural, social, and economic development in society.
4. To establish collaborations with various parties/institutions, both domestic and international, to support the implementation of the Tri Dharma of higher education.
5. To implement efficient, effective, and transparent educational administration to support the implementation of the Tri Dharma of higher education.

c. Objectives of the Physics Study Program

1. To produce professional, highly dedicated, and innovative graduates capable of applying science and technology to improve the quality of life in society by utilizing local natural resources.
2. To generate internationally competitive research in Physics that supports educational activities that leverage local natural resource potential.
3. To disseminate research findings in the form of community service, contributing to sustainable cultural, social, and economic development in society.
4. To establish broad collaborations with government and private institutions, both domestically and internationally, to support the implementation of the Tri Dharma of higher education at quality standards.
5. To implement efficient, effective, and transparent educational administration that supports the implementation of the Tri Dharma of higher education.

d. Targets and Strategies of the Physics Study Program

The Physics Study Program at the University of Mataram formulates the following targets and strategies to achieve its vision:

a. Targets

1. The implementation of innovative learning activities in accordance with the competencies of Physics Study Program graduates and aligned with the developments in science and technology based on local natural resources.
2. The implementation of internationally competitive research in Physics that supports educational activities leveraging local natural resource potential.
3. The implementation of community service activities based on faculty research findings to build sustainable cultural, social, and economic development in society.

4. The establishment of active collaborations with government and private institutions, both domestically and internationally, to support the implementation of the Tri Dharma of higher education at quality standards.
5. The implementation of efficient, effective, and transparent online-based administrative services to support the implementation of the Tri Dharma of higher education.

b. Strategies
1. Enhancing faculty competencies in their respective fields, improving the quality of education through strengthened content and computational skills, structured and systematic lesson planning, providing adequate learning infrastructure, and offering students the flexibility to engage in research and community service.
2. Increasing the number of research projects and faculty involvement in various research schemes with recognized and globally indexed scientific publications as outputs. Improving the quality and quantity of publications is also pursued through research and publication collaborations with colleagues within the faculty, the university, or other universities/institutions outside the university.
3. Expanding the number of activities and broadening the scope of community service, particularly in productive, remote, or disaster-prone areas.
4. Establishing collaborations with educational institutions to improve faculty qualifications, collaborative research, and teaching; with government or private institutions to enhance student learning competencies to support research and practical training, and with faculty collaboration research aimed at increasing the quality and quantity of publications.
5. Building a structured faculty and student administration system that supports the activities of the Tri Dharma of higher education.

4.4 *University Value*

1. University Value

The core values that characterize the University of Mataram include Integrity, Accountability, Innovation and Creativity, Striving for Excellence, Justice and Fairness, Collaboration, Transparency, Respect, and Sustainability.

1) *Integrity:* Upholding honesty, adhering to established standards, maintaining professionalism in work, committing to transparency and accountability in governance, and ensuring consistency in actions whether under supervision or not.
2) *Accountability: T*aking responsibility for all tasks, avoiding conflicts of interest that could harm the institution or the University of Mataram community, demonstrating discipline in effectively and efficiently fulfilling responsibilities, and engaging in proactive and highly initiative-driven actions that lead to quality outcomes.
3) *Innovative and Creative:* Generating new ideas, envisioning a bright future, anticipating and preparing for future needs, and producing beneficial new discoveries.

4) *Striving for Excellence:* Continuously striving for progress and excellence, providing the best not only for the University of Mataram but also for its marketplace.
5) *Just and Fair:* Offering equal opportunities and fair treatment without discrimination in carrying out duties, including in the development of academic and other activities, upholding honor by valuing justice, being responsive, and acting with courtesy.
6) *Collaborative:* Always collaborating to build synergy in achieving common goals, supporting each other's achievements with empathy, and upholding tolerance and a spirit of togetherness.
7) *Transparency:* Willingly sharing and disclosing all information to those who are entitled or concerned, except for confidential matters, with critical and careful consideration.
8) *Respect:* Valuing all individuals and work, avoiding belittlement or underestimation, and maintaining open lines of communication.
9) *Sustainability:* Ensuring continuous and sustainable improvement efforts in every program and activity.

2. Distinctiveness of the Department of Physics

The Department of Physics is one of the academic departments at the University of Mataram, under the Faculty of Mathematics and Natural Sciences (FMIPA). The University of Mataram is a public university located on Lombok Island, specifically in the city of Mataram, the capital of the West Nusa Tenggara Province. Lombok Island is part of the Lesser Sunda Islands, situated between subduction zones (Indo-Australian, Eurasian, Pacific plates), with notable volcanic features (Rinjani, Sangeang Api, Tambora) and numerous coastal areas that present both potential and challenges.

The presence of the Department of Physics contributes significantly to the development of natural resources and aids in addressing related issues, particularly in disaster mitigation and environmental fields. To realize these contributions, efforts are made to strengthen the Department of Physics to produce graduates with robust competencies in physics. The curriculum and learning processes are designed and implemented based on the potential of local natural resources. The distinctiveness of the Department of Physics at FMIPA University of Mataram lies in the application of physics and technological development tailored to the needs of island regions.

5. Graduate Profile and Learning Outcome Formulation (PLO)

5.1 Graduate Profile

Graduates of the Department of Physics at FMIPA, University of Mataram, are equipped with expertise in the concepts of physics, instrumentation, experimentation, and computation, thereby possessing competencies in these fields. The competencies provided are closely aligned with the skills required in the Industry 4.0 era, including data literacy,

technology literacy, and human literacy, as well as fostering high-order thinking skills. Graduates of the Physics program are prepared and expected to apply their competencies to compete in the job market and to meet global professional challenges.

The specializations offered to students in the Physics Study Program at FMIPA, University of Mataram, include competencies in earth physics/geophysics, material physics, instrumentation physics and biophysics, as well as theoretical and computational physics. Career prospects for Physics graduates include roles such as researchers, lecturers, laboratory technicians, and teachers, as well as practitioners in the mining sector, research and development, and/or quality assurance/control, software application developers, medical physicists, and entrepreneurs. Generally, the graduate profile is categorized into Researchers, Academics, Practitioners, and Entrepreneurs. The description of the graduate profile is presented in Figure 5.1 and Table 5.1.

Gambar 5.1. Graduate Profile Physics Study Program

Table 5.1. Profil Lulusan

Profil Lulusan	Deskripsi Kompetensi
Researcher Graduates can work in research institutions or in the research and development department of an organization, advancing scientific knowledge and developing methods for solving problems in the field of Physics, as well as producing technological product prototypes.	They possess competencies in physics concepts, problem-solving approaches, strong critical thinking and analytical skills, IT proficiency, the ability to plan research, collaboration skills, and the ability to professionally and responsibly present their work.
Academic Graduates can work as educators who transform scientific knowledge and competencies in the field of Physics.	They possess competencies in physics concepts, problem-solving approaches, strong critical thinking and analytical skills, IT proficiency, the ability to plan basic research, the ability to collaborate within a team, the ability to professionally and responsibly present their work, and competencies in advancing the field of Physics.
Practitioner Graduates work in formal or non-formal institutions that apply or utilize practical competencies in the field of Physics.	They possess competencies in physics concepts, practical analysis, critical thinking, the operation of technological equipment in the field of Physics, IT proficiency, the ability to collaborate within a team, and responsibility.
Entrepreneur Graduates can work as business owners, either independently or in collaboration	They possess problem-solving and critical thinking skills, IT proficiency, the ability to collaborate within a team, and the ability to professionally and responsibly present their work.

The Educational Objectives (TP) or Program Educational Objectives (PEO) of the Department of Physics at FMIPA, University of Mataram, aim to produce graduates who are capable of becoming researchers, academics, practitioners, and entrepreneurs with the following competencies:

TP 1: Mastery of physics knowledge and methodology, with the ability to apply them to solve problems related to the field of physics.

TP 2: Proficiency in information technology, computation, and data analysis, and the ability to adapt to their developments.

TP 3: The ability to advance knowledge through further study and self-development for lifelong learning.

TP 4: Keeping abreast of developments in the field of physics in line with advancements in science and technology, industry, and life in general.

TP 5: The ability to communicate ideas effectively, both orally and in writing, to take responsibility, to synergize and collaborate, as well as to take appropriate initiative and lead workgroups in areas relevant to their competencies.

5.2 Formulation of Program Learning Outcomes (PLO)

The Learning Outcomes (CP) or Program Learning Outcomes (PLO) are formulated based on graduate tracking results, input from stakeholders, professional associations, scientific consortia, trends in the development of science/skills, and curriculum evaluation results. The implemented learning must be able to foster problem-solving skills, investigative skills, communication skills, analytical skills, IT skills, personal skills, and ethical behavior.

The PLO formulation includes the skills required in the Industry 4.0 era, such as data literacy, technology literacy, and human literacy, as well as the ability to anticipate future developments. Technological advancements can be understood as the collaboration between humans and intelligent systems based on the Internet of Things (IoT) or cyber-physical systems, with the capability to use smart machines more efficiently in a more synergistic environment.

The Program Learning Outcomes of the Bachelor's Program in Physics consist of elements of attitudes, general skills, specific skills, and knowledge. The attitude and general skills elements refer to the SN-Dikti (minimum standards), supplemented by the study program to provide the distinct characteristics of university graduates. Meanwhile, the specific skills and knowledge elements are formulated with reference to the descriptors of the Indonesian National Qualifications Framework (KKNI) at the bachelor's level, as shown in Table 5.2a below.

Table 5.2a. Program Learning Outcomes of the Department of Physics Based on SN-Dikti

DOMAIN (SN-Dikti)	GRADUATE LEARNING OUTCOME
I. ATTITUDES (reflection of attitudes and values as citizens of Indonesia)	S1. Devout to God Almighty and capable of demonstrating religious behavior;
	S2. Uphold human values in carrying out duties based on religion, morals, and ethics;
	S3. Contribute to improving the quality of life in society, the nation, and the state, as well as advancing civilization based on Pancasila;
	S4. Act as citizens who are proud and love their homeland, possess nationalism, and have a

DOMAIN (SN-Dikti)	GRADUATE LEARNING OUTCOME
	sense of responsibility toward the country and nation;
	S5. Respect cultural diversity, views, religions, and beliefs, as well as others' original opinions or findings;
	S6. Cooperate and have social sensitivity and concern for society and the environment;
	S7. Abide by the law and discipline in societal and state life;
	S8. Internalize academic values, norms, and ethics;
	S9. Demonstrate responsibility for their work in their area of expertise independently;
	S10. Internalize the spirit of independence, struggle, and entrepreneurship.
II. KNOWLEDGE MASTERY (level of mastery, breadth, and depth of knowledge characteristic of the study program)	P1. Master theoretical concepts and fundamental principles of classical and modern (quantum) physics;
	P2. Master mathematical, computational, and instrumentation methods in physics;
	P3. Master knowledge about technology based on physics and its applications.
III. SPECIFIC SKILLS (specific work abilities related to the field of study or expertise of the program)	KK1. Capable of formulating physical phenomena and problems through analysis based on observational and experimental results;
	KK2. Capable of producing mathematical or physical models that align with hypotheses or predictions of the impact of phenomena under discussion;
	KK3. Capable of analyzing various alternative solutions to physical problems and drawing conclusions for accurate decision-making;
	KK4. Capable of predicting the potential application of physical behavior in technology;
	KK5. Capable of disseminating the results of studies on physical problems and behaviors

DOMAIN (SN-Dikti)	GRADUATE LEARNING OUTCOME
	of simple phenomena in the form of reports or papers in accordance with standard scientific principles.
IV. GENERAL SKILLS (general work abilities and responsibilities according to the level and type of higher education)	KU1. Capable of applying logical, critical, systematic, and innovative thinking in the context of developing or implementing science and/or technology according to their area of expertise;
	KU2. Capable of assessing the implications of developing or implementing science, technology, or art according to their expertise based on scientific principles, procedures, and ethics to produce solutions, ideas, designs, or art critiques, and compile a scientific description of their study results in the form of a thesis or final report;
	KU3. Capable of making accurate decisions in the context of problem-solving in their area of expertise, based on the analysis of information and data;
	KU4. Capable of managing independent learning,
	KU5. Capable of maintaining and developing work networks with supervisors, colleagues, peers, both within and outside their institution.

The reformulation of Program Learning Outcomes is carried out as part of the curriculum development based on Outcome-Based Education (OBE). Table 5.2b presents the reformulated Program Learning Outcomes based on OBE.

Table 5.2b. Reformulated Program Learning Outcomes based on OBE

No. PLO	Description of Program Learning Outcomes
PLO 1	Able to demonstrate religious behavior and practice the values of Pancasila in carrying out duties and responsibilities, contributing to the improvement of the quality of life in society, the nation, and the state.
PLO 2	Possesses a strong sense of nationalism and social concern, is disciplined and law-abiding, respects cultural diversity, is able to collaborate and upholds academic values, norms, and ethics, and possesses independence and entrepreneurial spirit.

PLO 3	Able to conduct studies based on logical, critical, systematic, and innovative thinking and able to formulate and implement the results of these studies in the context of solving problems in their area of expertise.
PLO 4	Motivated for continuous independent learning for self-development and able to collaborate and interact constructively with others.
PLO 5	Master theoretical concepts and fundamental principles of classical and modern (quantum) physics.
PLO 6	Master mathematical, computational, and instrumentation methods in physics.
PLO 7	Master knowledge about physics-based technology and its applications.
PLO 8	Able to formulate physical phenomena and problems through analysis based on observational and experimental results, and to develop appropriate mathematical or physical models.
PLO 9	Able to analyze various alternative solutions to physical problems and conclude for accurate decision-making.
PLO 10	Able to predict the potential application of physical behavior in technology and disseminate the results of problem-solving studies according to standard scientific principles.

The alignment between the Program Learning Outcomes of the Physics Study Program and the PLO established based on national standards (SN Dikti) for the four aspects (Attitudes [A], Knowledge [K], Specific Skills [SS], and General Skills [GS]) is mapped in Table 5.2c below.

Table 5.2c. Matrix of PLO Alignment (According to SN Dikti) with PLO

PLO (SN Dikti)	Program Learning Outcomes (PLO) OBE									
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10
A1	√									
A2	√									
A3	√	√								
A4		√								
A5		√								
A6		√								
A7		√								
A8		√								
A9	√									
A10		√								
K1					√					
K2						√				
K3							√			
SS1								√		
SS2								√		
SS3									√	
SS4										√
SS5										√
GS1			√							
GS2			√							
GS3			√							
GS4				√						

GS5				√						

5.3 Mapping of the Relationship between Learning Outcomes and Graduate Profiles

Based on the Program Learning Outcomes formulated by considering various aspects, the relationship between PLO and the graduate profiles can be mapped, as shown in Table 5.3 below.

Table 5.3. Mapping of the Relationship between PLO and Graduate Profiles

Learning Outcomes		Graduate Profile			
Domain	**Code**	**Researcher**	**Academic**	**Practitioner**	**Enterpreneur (Technopreneur)**
Attitudes	PLO 1	√	√	√	√
	PLO 2	√	√	√	√
General skills	PLO 3	√	√	√	√
	PLO 4	√	√	√	√
Knowledge	PLO 5	√	√		
	PLO 6	√	√	√	
	PLO 7	√	√	√	√
Specific skills	PLO 8	√	√		
	PLO 9	√	√	√	√
	PLO 10	√	√	√	

5.4 Mapping of the Relationship between PLO and Stakeholder Aspirations

The results of the previous curriculum evaluation and the needs analysis conducted through FGD and Tracer Study, grounded in philosophical, sociological, psychological, and legal foundations, have been translated into PLO as shown in Table 5.3. Subsequently, the formulated PLO is mapped against stakeholder aspirations to ensure that key aspects of these aspirations are accommodated in the PLO. This mapping is presented in Table 5.4 below.

Table 5.4. Mapping of Learning Outcomes with Stakeholder Aspirations

Learning Outcomes		Stakeholder Aspirations					
Domain	**Code**	**Government**	**Alumni**	**Alumni Employers**	**Professional Organizations/Program Study Associations**	**Institution/Unram**	**Benchmark**
Attitudes	S1 (PLO 1)	K	K	K	K	K	K
	S2 (PLO 1)	K	K	K	K	K	K
	S3 (PLO 1)	K	K	K	K	K	K
	S4 (PLO2)	K	K	K	K	K	K
	S5 (PLO 2)	K	K	K	K	K	K
	S6 (PLO 2)	K	K	K	K	K	K

Learning Outcomes		Stakeholder Aspirations					
Domain	**Code**	**Government**	**Alumni**	**Alumni Employers**	**Professional Organizations/Program Study Associations**	**Institution/Unram**	**Benchmark**
	A7 (PLO 2)	K	K	K	K	K	K
	A8 (PLO 2)	K	K	K	K	K	K
	A9 (PLO 1)	K	K	K	K	K	K
	A10 (PLO 2)	S	K	K	S	S	S
Knowledge	K1 (PLO 5)	S	K	S	S	K	S
	K2 (PLO 6)	S	K	S	S	K	S
	K3 (PLO 7)	S	K	S	K	K	S
Specific skills	SS1 (PLO 8)	S	K	S	S	K	S
	SS 2 (PLO 8)	S	S	S	S	K	S
	SS 3 (PLO 9)	K	K	S	S	K	S
	SS 4 (PLO 10)	S	S	S	K	K	S
	SS 5 (PLO 10)	S	K	S	K	K	S
General skills	GS1 (PLO 3)	K	K	K	K	K	K
	GS2 (PLO 3)	K	S	S	K	K	S
	GS3 (PLO 3)	K	S	S	K	K	K
	GS4 (PLO 4)	L	S	S	K	K	S
	GS5 (PLO 4)	K	K	K	K	K	K

Keterangan: K = Strong, S = Medium, L = Weak

5.5 Relationship between Study Program PLO and Program Educational Objectives

Table 5. Matrix of the Relationship between Study Program PLO and Program Educational Objectives

PLO Study Program		TP1	TP2	TP3	TP4	TP5
PLO 1	Able to demonstrate religious behavior and practice the values of Pancasila in carrying out duties and responsibilities, contributing to the improvement of the quality of life in society, the nation, and the state.					√
PLO 2	Possesses a strong sense of nationalism and social concern, is disciplined and law-abiding, respects cultural diversity, is able to collaborate and upholds academic values, norms, and ethics, and possesses independence and entrepreneurial spirit.					√
PLO 3	Able to conduct studies based on logical, critical, systematic, and innovative thinking, and able to formulate and implement the	√	√		√	√

	results of these studies in the context of solving problems in their area of expertise.					
PLO 4	Motivated for continuous independent learning for self-development and able to collaborate and interact constructively with others.			√		
PLO 5	Master theoretical concepts and fundamental principles of classical and modern (quantum) physics.	√	√	√	√	
PLO 6	Master mathematical, computational, and instrumentation methods in physics.	√	√	√	√	
PLO 7	Master knowledge about physics-based technology and its applications.	√	√	√	√	
PLO 8	Able to formulate physical phenomena and problems through analysis based on observational and experimental results, and to develop appropriate mathematical or physical models.	√	√		√	
PLO 9	Able to analyze various alternative solutions to physical problems and conclude for accurate decision-making.	√	√		√	
PLO 10	Able to predict the potential application of physical behavior in technology and disseminate the results of problem-solving studies according to standard scientific principles.			√	√	

6. Determination of Study Materials

6.1 Overview of the Body of Knowledge (BoK) of the Study Program

Study materials represent a series of knowledge from a specific discipline or knowledge learned by students and can be demonstrated by them (Anderson & Krathwohl, 2001:12-13). These study materials are an elaboration of the Learning Outcomes and graduate profiles, infused with the distinctive characteristics of the study program or university, which constitute the core focus of the Physics Study Program. These study materials are also aligned with the minimum requirements set by professional organizations or fields.

The primary focus of the Physics Study Program is the knowledge of concepts, fundamental principles, and methods in physics that graduates must understand and master. Physics is a field of quantitative measurement and requires proficiency in mathematics as an analytical tool to understand and apply the fundamental principles of physics. Students must master mathematical knowledge and techniques to attain the appropriate level of physics proficiency.

Physics is also a hierarchical discipline, where some topics are identified for in-depth study, requiring prerequisite knowledge to comprehend these topics fully. The study materials in physics must foster and enhance problem-solving skills, investigative skills, communication skills, analytical skills, information technology (IT) skills, personal skills, and ethical behavior. The functional relationship of the study materials that shape graduates of the Physics Study Program at FMIPA, University of Mataram, is described hierarchically in Figure 8.1.

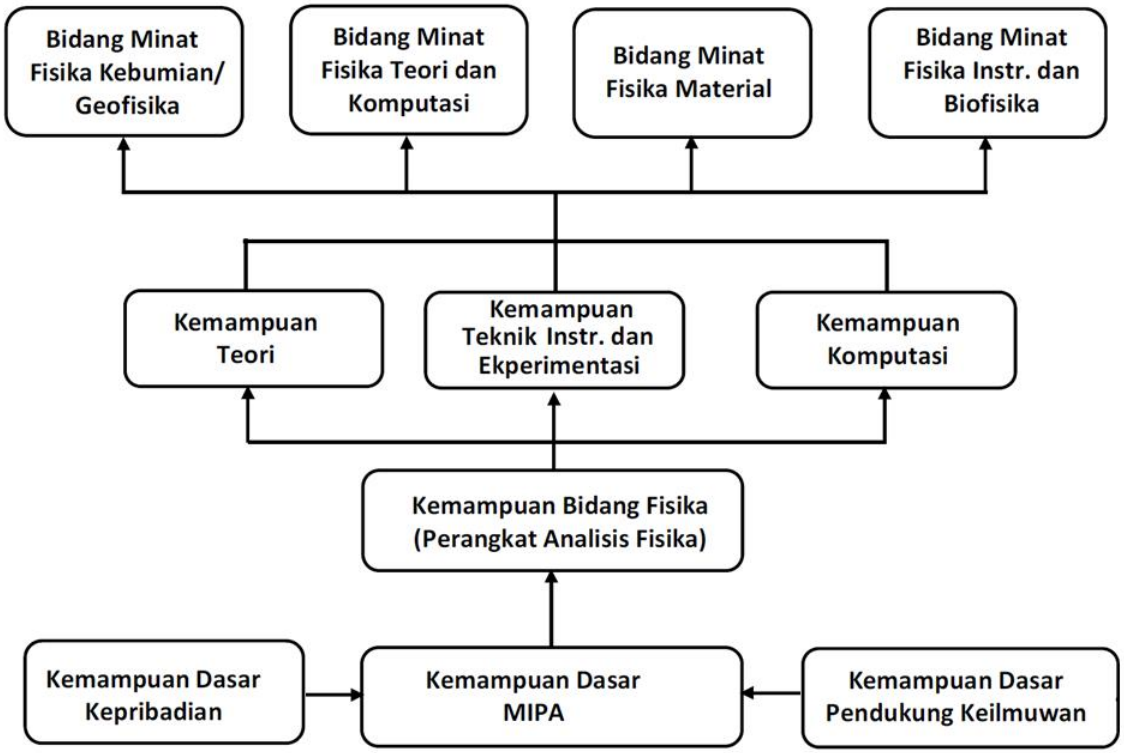

Figure 6.1. Functional Relationship of Physics Study Materials in the Physics Study Program

The study materials of the Physics Study Program consist of Core Study Materials and Supporting/Strengthening Study Materials. The Core Study Materials encompass the main topics of Physics, including Mechanics, Mathematical Physics, Electricity and Magnetism, Waves, Optics, Modern Physics, Thermodynamics and Statistical Physics, Nuclear Physics, Solid State Physics, and Quantum Physics.

The Supporting/Strengthening Study Materials include Mathematics and Statistics, Electronics, Physics Instrumentation, Programming and Computation, Earth Sciences, Language, and Ethics and Personality. Additionally, topics related to the unique characteristics of the Study Program, such as Small Islands and their potentials, are included.

All these study materials are embodied in courses that support the realization of graduate profiles and the achievement of the formulated Learning Outcomes (PLO). These study materials are then related to the scientific fields developed within the Physics Study Program at the University of Mataram.

6.2 Study Materials Based on the PLO of the Study Program

The Study Materials (BK) of the Physics Study Program at the University of Mataram, based on the PLO of the Physics Study Program, are as follows:

1. Developing the personality of graduates so that they can consistently embody the fundamental values of religion and culture, Pancasila, a sense of nationality, independence, and patriotism throughout their lives as a foundation for building their environment, becoming graduates who are resilient, adaptive, and ready to face global challenges.
2. Theoretical concepts and fundamental principles that form the core knowledge of Physics.
3. Mathematical and statistical methods as tools for problem-solving analysis.
4. Programming and Computation methods, Electronics, and Instrumentation for the application of Physics in the development of science and technology.
5. Study of investigative abilities, analytical skills, oral and written communication.
6. Study of experimentation, specialized fields of Physics interest, independent or collaborative research capabilities.

Table 6.2a. The Relationship Between Study Materials and PLO of the Physics Study Program at the University of Mataram

Description PLO Study Program		Bahan Kajian
PLO 1	Able to demonstrate religious behavior and practice the values of Pancasila in carrying out duties and responsibilities, contributing to the improvement of the quality of life in society, the nation, and the state.	BK 1
PLO 2	Possesses a strong sense of nationalism and social concern, is disciplined and law-abiding, respects cultural diversity, is able to collaborate and upholds academic values, norms, and ethics, and possesses independence and entrepreneurial spirit.	BK 1
PLO 3	Able to conduct studies based on logical, critical, systematic, and innovative thinking, and able to formulate and implement the results of these studies in the context of solving problems in their area of expertise.	BK 6
PLO 4	Motivated for continuous independent learning for self-development and able to collaborate and interact constructively with others.	BK 6
PLO 5	Master theoretical concepts and fundamental principles of classical and modern (quantum) physics.	BK 2

PLO 6	Master mathematical, computational, and instrumentation methods in physics.	BK 3
PLO 7	Master knowledge about physics-based technology and its applications.	BK4
PLO 8	Able to formulate physical phenomena and problems through analysis based on observational and experimental results, and to develop appropriate mathematical or physical models.	BK 5
PLO 9	Able to analyze various alternative solutions to physical problems and conclude for accurate decision-making.	BK 5
PLO 10	Able to predict the potential application of physical behavior in technology and disseminate the results of problem-solving studies according to standard scientific principles.	BK 5

Table 6.2b. Description of Study Materials for the Physics Study Program at the University of Mataram

No.	Aspect	Study Materials
1	**Attitude**	**Study Material 1: Developing the personality of graduates so that they can consistently embody the fundamental values of religion and culture, Pancasila, nationalism, independence, and lifelong patriotism as a foundation for building their surroundings, becoming graduates who are resilient, adaptive, and ready to face global challenges.**
	1. Able to demonstrate religious behavior and practice the values of Pancasila in carrying out duties and responsibilities that contribute to improving the quality of life in society, the nation, and the state. (PLO 1)	• Development of knowledge elements on religion, diversity attitudes, the skill to practice religious teachings, commitment to religion, confidence as a believer, and implementing religious teachings to form a complete personality with religion as the foundation for thinking, behaving, and acting in the development of science and profession. • Pancasila in the context of Indonesia's history as the state's foundation, state ideology, philosophical system, ethical system, and basis for scientific development. Understanding and internalizing the values of Pancasila as both a state philosophy and national ideology scientifically. The values of Pancasila will be internalized as guiding principles in developing professionalism in each field, in society, and in response to changing times.
	2. Possesses a strong sense of nationalism and social concern, is disciplined and law-abiding, respects cultural diversity, is able to collaborate and upholds academic values, norms, and ethics, and possesses	• Entrepreneurial spirit, thinking about change in factual contexts related to business and management, creative thinking, action-oriented concepts in line with entrepreneurial theory, risk-taking based on self-evaluation, leadership in the global community, business ethics contributing to societal life, personal competency development, finding and innovating business ideas,

	independence and an entrepreneurial spirit. (PLO 2)	marketing function analysis, financial and business management, and implementing new business ventures with business plans.
2	**Knowledge Mastery**	**Study Material 2: Theoretical concepts and fundamental principles that form the core knowledge of Physics.** **Study Material 3: Mathematical and statistical methods as tools for problem-solving analysis.** **Study Material 4: Programming and Computation methods, Electronics, and Instrumentation for the application of Physics in the development of science and technology.**
	1. Master theoretical concepts and fundamental principles of classical and modern (quantum) physics. (PLO 5)	**Newtonian Mechanics for Single Particles:** • Basic quantities of motion (kinematics of motion) • Types of motion: motion along a straight line, motion on a plane, motion in space, relative motion (relative position and velocity). • Analysis of a particle's motion in curvilinear coordinates (polar, spherical, cylindrical). • Newton's laws of motion, inertial and non-inertial reference frames, inertial mass and gravitational mass, force and momentum, torque and angular momentum (with respect to the center of coordinates and other points), and Newton's laws for rotational motion. • Applications of Newton's laws of motion: force equilibrium, time-dependent forces (e.g., impulse forces), position-dependent forces (e.g., restorative forces, Newtonian gravitational forces), velocity-dependent forces (e.g., Stokes forces, drag force), and their combinations (e.g., combination of spring and friction forces). • Concepts of work and energy, work-kinetic energy theorem, conservative forces and potential energy, the law of conservation of energy, and its applications. • Newton's law of gravitation: gravity in systems of point masses and continuous bodies, gravitational potential energy. • Linear oscillation: objects on springs, simple harmonic motion, damped oscillation, forced oscillation, coupled oscillations. **Mechanics of Systems of Many Particles:** • **Motion of many-particle systems:** linear momentum and angular momentum of the system, conservation of linear momentum and angular momentum, center of mass motion, total force and torque, kinetic energy of the system, center of mass frame, collisions.

		• **Rigid body motion:** Pure rotation (rigid body rotation with a fixed axis): moment of inertia, kinetic energy, application of Newton's second law to rotational motion, conservation of angular momentum; Mixed motion (rotation and translation of a rigid body): angular momentum, kinetic energy, inertia tensor, conservation of angular momentum, examples of mixed rotation: planar motion (rolling motion), gyroscope motion. • **Non-inertial reference frames:** Accelerated reference frames and inertial forces (fictitious forces), rotating reference frames (centrifugal and Coriolis acceleration), dynamics of particles in rotating reference frames, effects of Earth's rotation (Foucault pendulum, trade winds, climate change). • **Lagrangian and Hamiltonian formulations:** Constraints, general coordinate systems, phase space of velocity and momentum, Hamilton's principle and Euler-Lagrange equations, Lagrangian function and energy function, generalized momentum, Hamiltonian equations. • **Motion in a central force field:** Kepler's laws, conic section equations in polar coordinates, central force and angular momentum conservation, derivation of equations of motion for a central potential, finding solutions to motion equations for Kepler potential (-K/r), gravitational potential energy field. • **Waves:** Harmonic oscillation, wave superposition, plane waves, harmonic waves, wave equations and solutions, wave superposition (interference and diffraction), wave energetics, reflection and refraction, standing waves, dispersion, mechanical waves: sound waves in solids, liquids, and gases, spherical and cylindrical waves, electromagnetic waves (introduction), multidimensional waves, medium impedance, dispersion relation, boundary propagation effects, Doppler effect. • **Theory of Relativity:** Space and time (Einstein's spacetime concept), concept of inertial reference frames, special relativity postulates, Lorentz transformation, special relativity phenomena: length contraction, time dilation, twin paradox, special relativity and electrodynamics, covariant formulation, introduction to general relativity (principles of equivalence and their qualitative effects). • **Fluid Concepts:** Euler and Lagrange descriptions, particle concept in fluids, streamline, trajectory, continuity equation for incompressible fluids. • **Ideal Fluid:** Euler equation, Bernoulli equation, hydrostatic pressure, energy flow density, momentum flow density, circulation conservation law, potential flow, drag force.

		• **Viscous Fluid:** Navier-Stokes equation, energy dissipation and incompressible fluid, Stokes force, viscous fluid flow in pipes, Reynolds number, dynamical equation in various curvilinear coordinates.
		Thermodynamics • Zeroth law of thermodynamics, concept of temperature, thermodynamic systems, quantities, phases, and phase transitions (solid, liquid, and gas). • Ideal gas: equation of state, heat and heat capacity, specific heat, non-ideal gas equation of state. • First law of thermodynamics. • Second law of thermodynamics: entropy, principle of maximum entropy, Carnot cycle. • Entropy and energy as thermodynamic potentials, Legendre transformation, free energy, enthalpy. • Maxwell relations. **Statistical Physics** • Phase space, distribution functions and probability, macrostates, microstates, particle statistics (Bose-Einstein, Fermi-Dirac, Maxwell-Boltzmann), statistical definition of entropy, ensemble theory and microcanonical ensemble, canonical ensemble. • Kinetic theory of ideal gas, pressure, work, and chemical potential. **Electromagnetism** • Experimental basis of Coulomb's law, Coulomb's law. • Static electric field due to point particles, static electric field due to discrete and continuous charge distributions, and electric dipoles, electric field lines and electric flux, Gauss's law. • Work and electric potential energy, electric potential, multipole expansion, Poisson's and Laplace's equations, boundary condition problems. • Conductors, insulators, and semiconductors. • Capacitors, capacitance, and dielectric materials. • Electrostatics in materials. • Electric current and current density, continuity equation. • Experimental basis of static magnetism, magnetic induction, motion of charged particles in a magnetic field, equations for stationary magnetic fields, vector potential, Faraday's law, magnetic dipole, and its field. • Magnetism in materials, permeability, magnetization, susceptibility. • Maxwell's equations, Electromagnetic Waves.

		• Covariant formulation of Maxwell's equations. • Physical optics, Geometrical optics, Optical instruments. • Polarization of electromagnetic waves, propagation of light in and between media, Fermat's principle, effects of anisotropic media. **Quantum Theory** • Blackbody radiation, photoelectric effect experiment, Compton effect, electron diffraction (Davisson-Germer experiment), Bohr atom model, pair production, wave-particle duality, de Broglie hypothesis, Heisenberg uncertainty principle. • Wave mechanics: Schrödinger equation, interpretation of the wave function, wave normalization, eigenvalues, eigenfunctions, degeneracy, operators, and expectation values. • Solutions to the Schrödinger equation: free particle, step potential, potential well, tunneling effect, simple harmonic oscillator, hydrogen atom, angular momentum. • Time-independent perturbation theory: non-degenerate cases, degenerate cases, fine structure of the hydrogen atom, Zeeman effect. • Approximation methods: perturbation theory (time-dependent: two-state systems, emission, and absorption), WKB approximation. • Introduction to relativistic quantum mechanics: Klein-Gordon equation, Dirac equation, second quantization. **Structure of Matter** • Crystal structure: symmetry and crystal structure, crystal lattice diffraction, atomic bonding in crystals. • Crystal lattice dynamics: vibrations in solids, heat capacity of solids, lattice vibrations. • Free electron model: classical free electron model, quantized free electron model, electron behavior in metals, objections to the free electron model. • Band theory: band theory, LCAO method, electron dynamics in metals. • Semiconductors: classification of semiconductors based on groups in the periodic table, intrinsic and extrinsic semiconductors. • Dielectric materials: macroscopic and microscopic views, dielectric phenomena, and magnetic materials: magnetic susceptibility, magnetic phenomena. • Structure and properties of atomic nuclei: nuclear composition, size, and shape of atomic nuclei, angular momentum and magnetic moment of nuclei, nuclear force (interaction between nucleons in the atomic nucleus), nuclear stability, nuclear binding energy, Weiszaecker's semi-empirical formula. • Nuclear models: shell model, liquid drop model.

		• Radioactivity: fundamental quantities of radioactivity, decay chains, radioactive equilibrium, artificial radioactivity. • Types of nuclear radiation: alpha decay, beta decay, gamma decay. • Nuclear reactions: classification of nuclear reactions, mechanisms of nuclear reactions, kinematics of nuclear reactions, nuclear reaction parameters. • Standard model of elementary particles: baryons, mesons, leptons, quarks.
	2. Master mathematical, computational, and instrumentation methods in physics. (PLO 6)	**Mathematical Methods** • Series: infinite series, power series, convergence tests and convergence domains of series, expansion of functions into power series, Fourier series. • Algebra and complex functions: analytic functions, contour integrals, Laurent series, residue techniques, conformal mapping. • Ordinary differential equations (ODEs): solutions of ODEs (separation of variables, series expansion for Bessel and Legendre ODEs), non-homogeneous ODEs, series solutions of ODEs, Frobenius method. • Partial differential equations (PDEs): wave equation, Laplace and Poisson equations, heat and diffusion equations, solutions using the method of separation of variables. • Integral transforms: Laplace transform, Fourier transform, convolution, Green's function, solutions of PDEs using transforms; integral equations. • System of linear equations, matrices, determinants; vector addition and multiplication, linear transformations, orthogonal transformations, eigenvalue problems, diagonalization. • Vector calculus: scalar fields, vector fields, gradient, divergence, curl, Green's theorem, Gauss's theorem, Stokes's theorem. • Coordinate systems: coordinate transformations, curvilinear coordinates, Cartesian tensors, spherical tensors. • Gamma function, beta function, error function, elliptic integrals, orthogonal functions, Bessel functions, Legendre functions, recurrence relations, Legendre series, Hermite functions, Laguerre functions. • Calculus of variations: Euler's equation, Lagrange's equation. • Probability definition: sample space, counting methods, random variables, continuous distributions, binomial distribution, normal (Gaussian) distribution, Poisson distribution.

		Computational Methods • Error analysis due to rounding and truncation in data storage and processing. • Introduction to the characteristics of decimal, binary, and floating-point numbers. • Calculating the roots of polynomial equations: Bracket methods (Bisection, regula falsi, Interpolation), open methods (Newton's, secant, interpolation, inverse interpolation, Brent). • Matrices (basic operations, linear equations, transformations, tridiagonal, identity, inversion, LU decomposition). • Solving linear equations: Gauss-Seidel, Gauss-Jordan, curve fitting methods (linear, polynomial, exponential), interpolation, and extrapolation. • Solution of differential equations: Euler and Runge-Kutta methods. • Finite difference equations: elliptic and parabolic equations, boundary condition problems, and eigenvalue problems. • Numerical integration: rectangle, trapezoid, Romberg, Newton-Cotes integration (Simpson's, Simpson's 3/8th, Boole's), and Gaussian integration. • Finite element method, Fast Fourier Transform (FFT). • Linear algebra iteration: LU matrix decomposition, Eigenvalues, Norms, Jacobi method, Gauss-Seidel. • Programming for root-finding, Optimization, finite difference equations. • Visual graphics programming and animation of calculation results.
		Electronics and Instrumentation • DC circuits, current source, voltage source. • Thevenin equivalent circuit, Norton equivalent circuit. • AC circuits. • Semiconductors, PN junction, diodes, full-wave rectifier, DC power supply, Zener diode, Bipolar Transistor, transistor characteristics, AC and DC load lines, transistor as a small-signal amplifier, Field-Effect Transistor (FET), JFET, MOSFET, transistor switch, multivibrator, bistable, astable, monostable. • Filters: passive filters, amplitude response, phase response, Bode plot, low-pass filters, high-pass filters. • Inverting amplifier, non-inverting amplifier, summing amplifier, current amplifier, power amplifier, determination of amplifier efficiency.

		• Digital circuit theory: AND, OR, NOT, NAND, NOR, and XOR. • Basic measuring instruments: current, voltage, and resistance meters. • Regulated power supply, switching power supply. • Input devices: sensors, types of sensors: temperature sensors, mechanical quantity sensors, optical sensors, magnetic sensors, and other sensors. • Simple signal processing: pre-signal processing, signal amplification, analog-to-digital conversion, microprocessor basics, S/N ratio enhancement. • Output devices: principles of operation for output devices such as memory, display, and printer.
	3. Master knowledge about physics-based technology and its applications. (PLO 7)	• A number of concepts/principles/materials in point a support the development of technology, including: Electromagnetism: ICT technology, instrumentation, geophysics, mining, acoustic and optical technology, communication technology, transportation technology, etc. Mechanics: building technology, marine technology, aviation technology, transportation technology, etc. Radiation and radioactivity: nuclear technology, health technology, biotechnology, etc. Quantum theory: material technology, transportation technology, etc. Relativity theory: communication technology, navigation, remote sensing, etc. Thermodynamics: mechanical technology, transportation technology, etc. • Specific and advanced materials in various research fields developed by the department/faculty running the study program. Examples include studies on local natural resources (volcanoes, coastal areas, mining) and disaster mitigation.
3.	**Specific Skills**	**Study Material 5: Study of investigative abilities, analytical skills, oral and written communication.**
	1. Able to formulate physical phenomena and problems through analysis based on observations and experiments (PLO 8)	Laboratory work that includes classical and quantum concepts, with an initial emphasis on experimental methods (measurement, data processing, data analysis).
	2. Able to produce mathematical or physical models that align with hypotheses or predictions of the impacts of the phenomena under discussion (PLO 8).	Relevant physics concepts.

	3. Able to analyze various alternative solutions to physical problems and conclude to make the right decisions (PLO 9).	Comprehensive physics concepts using numerical and analytical methods, computation, optimization, and physics concepts, along with literature review.
	4. Able to predict the potential application of physical behavior in technology (PLO 10).	Comprehensive physics concepts and literature review.
	5. Able to disseminate the results of studies on physical problems and behaviors of simple phenomena in the form of reports or papers according to standard scientific guidelines (PLO 10).	Providing the ability to create written reports (laboratory reports, papers, theses) in accordance with standard scientific writing guidelines and to present them.
4.	**General Skills**	**Study Material 6: Experimentation studies, physics specialization development, independent or collaborative research abilities**
	1. Applying logical, critical, systematic, and innovative thinking in the context of developing or implementing science and/or technology according to their field of expertise (PLO 3).	Lectures, open-ended laboratory work, internships, final research projects: comprehensive physics concepts; concepts in specific areas of expertise (geophysics, material physics, theoretical and computational physics, instrumentation, and biophysics).
	2. Assessing the implications of the development or implementation of science, technology, or arts according to their expertise, based on scientific principles, procedures, and ethics to generate solutions, ideas, designs, or art critiques, and compiling scientific descriptions of the study results in the form of theses or final project reports (PLO 3).	Internship activities; preparing internship reports. Final research project activities; preparing final project reports with comprehensive physics concepts; concepts in specific areas of expertise (geophysics, material physics, theoretical and computational physics, instrumentation, and biophysics).
	3. Making accurate decisions in the context of solving problems in their field of expertise, based on the analysis of information and data (PLO 3).	Final research project (thesis) activities, data analysis incorporating comprehensive physics concepts.
	4. Managing learning independently (PLO 4)	Final research project activities; internships, coursework designed to enhance independence.

	5. Developing and maintaining a network with supervisors, colleagues, and peers both within and outside their institution (PLO 4)	Group research activities and becoming part of a research group, internships.

The field of physics has several developments based on areas of study. In the field of computation, development includes artificial intelligence, machine learning, and their utilization in solving physical problems. In the field of electronics and instrumentation, development includes smart devices and sensor systems with high reliability. In the field of materials, development includes advanced materials and nanomaterials. In the field of earth sciences, it relates to earth phenomena and disaster mitigation. In the field of medical physics, development includes the advancement of radiation medical equipment and nuclear medicine using the principles of medical physics. Physics as a body of knowledge itself studies natural phenomena using the language of mathematics. Based on the study materials and the development of physics within the study program, a matrix of the correlation between study areas or fields of knowledge with the study materials is created, as outlined in Table 6.2 below.

Table 6.3. Relationship between Field of Study and Study Material

Field of Study	Study material																		
	Core													Supporting/Strengthening					
	Classical Mechanics	Thermodynamics	Termodinamika	Electricity and Magnetism	Waves	Modern Optics	Modern Physics	Statistical Physics	Nuclear Physics	Solid State Physics	Quantum Physics	Electronics & Instrumentation	Physics Experiments	Computation	Mathematics and Statistics	Earth Sciences	Language	Ethics and Personality	Data Analysis	Entrepreneurship/Institutional Characteristics
Computational and Theoretical Physics	K	K	S	K	K	S	K	K	S	S	K	S	L	K	K	L	S	S	K	L
Materials	S	S	K	S	K	K	S	K	S	K	S	K	K	K	K	L	S	S	K	L
Instrumentation and Biophysics	S	S	S	K	K	S	S	S	K	S	S	K	K	K	S	L	S	S	K	L
Geophysics	S	S	S	K	K	S	L	L	L	L	L	S	K	K	S	K	S	S	K	S

Notes: K = Strong, S = Moderate, L = Weak

6.3 Explanation and Mapping of Learning Outcomes into Study Material

The knowledge elements from the Learning Outcomes (PLO) that have been derived from the body of knowledge process should have illustrated the boundaries and scope of the field of study/expertise, representing the minimal study materials that every graduate of the study program must master. These study materials can consist of one or more branches of science

along with their subfields, or a group of knowledge that has been integrated into a new knowledge area that has been agreed upon by similar study program forums as the characteristic field of the study program. From these minimal study materials, the study program can further detail the level of mastery, breadth, and depth. The study materials in the curriculum then become the content standard of learning, with a level of depth and breadth that refers to the PLO. The level of depth and breadth of learning materials is adjusted to the National Higher Education Standards (SN Dikti).

Study materials and learning content can be updated or developed according to the development of science and technology and the direction of the study program's own scientific development. The process of determining study materials needs to involve the scientific field/laboratory groups within the study program. The formation of a course based on selected study materials can begin by creating a matrix between the formulation of PLO (attitudes, general skills, specific skills, and knowledge) and the study materials, to ensure their correlation.

7. Formation of Courses and Determination of Credit Weights (SKS)

This stage is divided into two activities: first, selecting several relevant PLO items as the basis for course formation, ensuring that each course contains elements of knowledge, skills, and attitudes. Simultaneously, the study materials contained in these PLO items are selected, which are then detailed in the learning materials for that course. Based on the PLO, Study Materials, Field of Study, and the unique characteristics of the Physics Study Program at Unram, which includes small islands and their potential, courses are formed with the following assigned outcomes:

Table 7.1. Matrix for the Formation of New Courses Based on the PLO Assigned to Courses

Courses	Learning Outcomes																					
	Attitudes (A)										Knowledge (K)			Specific skills (SS)					General skills (GS)				
	A1 (PLO 1)	A2 (PLO 1)	A3 (PLO 1)	A4 (PLO 2)	A5 (PLO 2)	A6 (PLO 2)	A7 (PLO 2)	A8 (PLO 2)	A9 (PLO 1)	A10 (PLO 2)	K1 (PLO 5)	K2 (PLO 6)	K3 (PLO 7)	SS1 (PLO 8)	SS2 (PLO 8)	SS3 (PLO 9)	SS4 (PLO 10)	SS5 (PLO 10)	GS1 (PLO 3)	GS2 (PLO 3)	GS3 (PLO 3)	GS4 (PLO 4)	GS5 (PLO 4)
A. Compulsory Courses																							
Education of Religion	√	√				√	√		√														
Pancasila	√	√	√	√	√			√			√											√	√
National Resilience				√		√	√			√	√												
Indonesia Language								√			√												
Research Methodology									√				√					√		√			
Field Work								√	√				√	√				√	√			√	√

Courses	Learning Outcomes																				
	Attitudes (A)										Knowledge (K)			Specific skills (SS)					General skills (GS)				
	A1 (PLO 1)	A2 (PLO 1)	A3 (PLO 1)	A4 (PLO 2)	A5 (PLO 2)	A6 (PLO 2)	A7 (PLO 2)	A8 (PLO 2)	A9 (PLO 1)	A10 (PLO 2)	K1 (PLO 5)	K2 (PLO 6)	K3 (PLO 7)	SS1 (PLO 8)	SS2 (PLO 8)	SS3 (PLO 9)	SS4 (PLO 10)	SS5 (PLO 10)	GS1 (PLO 3)	GS2 (PLO 3)	GS3 (PLO 3)	GS4 (PLO 4)	GS5 (PLO 4)
Community Services			√	√	√	√	√		√							√			√				
Thesis								√	√			√	√	√		√				√			√
Fundamental Biology									√		√					√		√	√				
Practicum of Fundamental Biology									√		√			√				√	√				
Fundamental Physics								√	√		√			√		√			√				
Practicum of Fundamental Physics						√		√	√			√	√	√	√				√			√	
Fundamental Chemistry									√		√			√								√	
Practicum of Fundamental Chemistry									√		√	√		√				√		√		√	
Fundamental Mathematics									√			√				√			√				
English Language					√	√		√	√										√	√		√	
Advanced Basic Physics								√	√	√				√		√			√				
Practicum of Advanced Basic Physics						√		√	√			√	√	√	√				√			√	
Statistics									√			√				√			√				
Computer Programming									√			√			√				√				
Mathematical Physics 1	√							√	√	√	√				√				√				
Mathematical Physics 2									√	√		√			√				√				
Classical Mechanics									√	√	√				√				√				
Thermodynamics									√		√						√		√				
Fundamental Electronics									√			√		√		√			√				
Experimental Physics 1								√	√			√	√	√				√	√		√		
Numerical Methods									√			√				√			√				
Modern physics									√		√				√		√		√			√	
Electromagnetism									√		√				√				√				
Instrumentation Physics									√			√				√			√				
Waves									√				√					√			√		
Experimental Physics 2								√	√			√	√	√				√	√		√		

Courses	Learning Outcomes																				
	Attitudes (A)										Knowledge (K)			Specific skills (SS)					General skills (GS)				
	A1 (PLO 1)	A2 (PLO 1)	A3 (PLO 1)	A4 (PLO 2)	A5 (PLO 2)	A6 (PLO 2)	A7 (PLO 2)	A8 (PLO 2)	A9 (PLO 1)	A10 (PLO 2)	K1 (PLO 5)	K2 (PLO 6)	K3 (PLO 7)	SS1 (PLO 8)	SS2 (PLO 8)	SS3 (PLO 9)	SS4 (PLO 10)	SS5 (PLO 10)	GS1 (PLO 3)	GS2 (PLO 3)	GS3 (PLO 3)	GS4 (PLO 4)	GS5 (PLO 4)
Solid state Physics									√		√					√			√				
Statistical Physics									√		√				√					√			
Computational Physics									√			√				√					√		
Modern Optics									√		√				√				√				
Nuclear Physics									√		√					√			√				
Quantum Physics									√		√				√				√				
Introduction to Geophysics				√					√				√	√					√		√		
Data Science									√			√			√						√		
Entrepreneurship									√	√	√								√		√		
Seminar			√					√	√			√							√	√			
Scientific Articles Writing								√	√			√					√	√	√			√	
B. Elective Courses																							
Electrodynamics									√		√				√				√				
Quantum Mechnics									√		√				√					√			
Quantum Optics									√		√				√					√			
Quantum Information and Computation									√		√				√					√			
Advance Computational Physics									√			√				√					√		
Einstein Relativistic Teori									√		√					√					√	√	
Statistical Mechanics	√							√	√	√	√				√				√				
Advance Electronics						√		√	√				√				√		√				
Signal Processing									√				√				√		√		√		
Sensor and Actuator System						√		√	√				√				√		√			√	
Data Acquisition System									√				√			√			√				
Electrical Circuit									√				√		√				√				
Biosensor						√		√	√				√				√		√				
Radiation Physics									√		√		√			√			√				
Radiotherapy						√			√		√		√		√				√				
Medical and Nuclear Instrumentation									√				√				√		√				
Medical Computation Physics									√	√		√			√				√				

Courses	Learning Outcomes																				
	Attitudes (A)										Knowledge (K)			Specific skills (SS)					General skills (GS)				
	A1 (PLO 1)	A2 (PLO 1)	A3 (PLO 1)	A4 (PLO 2)	A5 (PLO 2)	A6 (PLO 2)	A7 (PLO 2)	A8 (PLO 2)	A9 (PLO 1)	A10 (PLO 2)	K1 (PLO 5)	K2 (PLO 6)	K3 (PLO 7)	SS1 (PLO 8)	SS2 (PLO 8)	SS3 (PLO 9)	SS4 (PLO 10)	SS5 (PLO 10)	GS1 (PLO 3)	GS2 (PLO 3)	GS3 (PLO 3)	GS4 (PLO 4)	GS5 (PLO 4)
Biophysics						√			√		√					√			√				
Gravity and Magnetics Method									√				√			√				√			
Geoelectrical and electromagnetic Method									√				√	√				√			√		
Geological Geophysics				√					√				√	√					√		√		
Mapping and GIS									√				√	√			√		√		√		
Environmental Geophysics	√								√			√	√					√			√		
Seismic Method						√			√			√	√	√			√		√				
Seismology									√				√					√			√	√	
Geothermal									√				√				√				√		
Vulcano Physics	√								√			√	√					√			√		
Introduction to Meteorology									√		√				√				√				
Material Physics									√		√				√				√				
Biomaterial									√				√	√				√	√				
Material Computational Physics									√				√	√		√			√				
Composite Material									√	√			√		√		√		√				
Thin Layer Technology			√						√		√		√	√		√			√		√		
Membrane Technology										√			√		√		√		√				
Material Characterization Method									√	√	√				√				√				
Nano-Particle and dan Nano-technology									√	√	√				√				√				
Material Synthesis Method									√	√			√		√		√		√				
AI and Machine Learning									√			√			√						√		
Embedded system and IOT						√		√	√				√				√		√				
Energy Physics			√						√		√		√	√		√	√	√	√			√	
Environmental Physics									√		√		√			√			√		√		
Kapita Selecta								√	√			√				√			√				
English for Academic Purpose			√		√									√				√		√			

Based on the assignment of learning outcomes to each formed course, the credit weight (SKS) and prerequisites for each course are then determined according to Table 7.2. The credit weight for each course is detailed based on the characteristics of the course delivery. If the course is delivered through face-to-face instruction with 2 SKS (e.g., 2 (2-0)), if it includes laboratory/field practice for 2 SKS, it is written as 2(0-2), and for a combination, for example, a 3 SKS course with 2 SKS of face-to-face instruction and 1 SKS of laboratory work, it is written as 3(2-1). The credit weight for each course is also supplemented with a conversion to the European Credit Transfer and Accumulation System (ECTS).

Table 7.2. Courses and Assigned Credit Weights

Course Code	PLO	Courses/Field of Study	Theory	Practice/ Practicum	SKS	ECTS
MKU21001	1,2,4	Education of Religion	2	-	2 (2-0)	3,2
MKU21002	1,2,4	Pancasila	2	-	2 (2-0)	3,2
MKU21003	1,2,3	National Resilience	2	-	2 (2-0)	3,2
MKU21004	2,3,10	Indonesia Language	2	-	2 (2-0)	3,2
MKF21001	1,3,7,10	Research Methodology	2	-	2 (2-0)	3,2
MKF21002	1,2,3,4,7,8, 10	Field Work	2	-	2 (2-0)	3,2
MKF21003	1,2,3,9	Community Services	-	4	4 (0-4)	6,4
MKF21004	1,2,3,4,6,7, 8,9	Thesis	6	-	6	9,6
MKF21005	1,3,5,9,10	Fundamental Biology	3	-	3 (3-0)	4,8
MKF21006	1,3,5,8,10	Practicum of Fundamental Biology	-	1	1 (0-1)	1,6
MKF21007	1,2,3,5,8,9	Fundamental Physics	3	-	3 (3-0)	4,8
MKF21008	1,2,3,6,7,8	Practicum of Fundamental Physics	-	1	1 (0-1)	1,6
MKF21009	1,4,5,8	Fundamental Chemistry	3	-	3 (3-0)	4,8
MKF21010	1.3.4.5.6.8. 10	Practicum of Fundamental Chemistry	-	1	1 (0-1)	1,6
MKF21011	1,3,6,9	Fundamental Mathematics	4	-	4 (4-0)	6,4
MKF21012	1,2,3,4,10	English Language	2	-	2 (2-0)	3,2
FIS21201	1,2,3,8,9	Advanced Basic Physics	3	-	3 (3-0)	4,8
FIS21202	1,2,3,4,6,7, 8	Practicum of Advanced Basic Physics	-	1	1 (0-1)	1,6
FIS21203	1,3,6,9	Statistics	3	-	3 (2-1)	4,8
FIS21204	1,3,6,8	Computer Programming	2	1	3 (2-1)	4,8
FIS21205	1,2,3,5,8	Mathematical Physics 1	4	-	4 (4-0)	6,4
FIS21306	1,2,3,6,8	Mathematical Physics 2	4	-	4 (4-0)	6,4
FIS21307	1,2,3,5,8	Classical Mechanics	4	-	4 (4-0)	6,4
FIS21308	1,3,5,10	Thermodynamics	3	-	3 (3-0)	4,8
FIS21309	1,3,6,8,9	Fundamental Electronics	4	1	4 (3-1)	6,4
FIS21310	1,2,3,6,7,8, 10	Experimental Physics 1	0	2	2 (0-2)	3,2
FIS21312	1,3,6,9	Numerical Methods	3	-	3 (3-0)	4,8
FIS21413	1,3,5,8	Electromagnetism	4	-	4 (4-0)	6,4

Course Code	PLO	Courses/Field of Study	Theory	Practice/ Practicum	SKS	ECTS
FIS21414	1,3,5,8,10	Modern physics	3	-	3 (3-0)	4,8
FIS21415	1,3,6,9	Instrumentation Physics	3	1	4 (3-1)	6,4
FIS21416	1,3,7,10	Waves	3	-	3 (3-0)	4,8
FIS21411	1,2,3,6,7,8, 10	Experimental Physics 2	-	2	2 (0-2)	3,2
FIS21417	1,3,5,9	Solid state Physics	4	-	4 (4-0)	6,4
FIS21518	1,3,5,8	Statistical Physics	3	-	3 (3-0)	4,8
FIS21519	1,3,6,9	Computational Physics	3	-	3 (3-0)	4,8
FIS21520	1,3,5,8	Modern Optics	3	-	3 (3-0)	4,8
FIS21521	1,3,5,9	Nuclear Physics	3	-	3 (3-0)	4,8
FIS21522	1,3,5,8	Quantum Physics	4	-	4 (4-0)	6,4
FIS21523	1,2,3,7,8	Introduction to Geophysics	3	-	3 (3-0)	4,8
FIS21624	1,3,6,8	Data Science	3	-	3 (3-0)	4,8
FIS21625	1,2,3,9	Entrepreneurship	2	-	2 (2-0)	3,2
FIS21626	1,2,3,6	Seminar	2	-	2 (2-0)	3,2
FIS21827	1,2,3,4,6, 10	Scientific Articles Writing	2	-	2 (2-0)	3,2
PIF21001	1,3,5,8	Electrodynamics	3	-	3 (3-0)	4,8
PIF21002	1,3,5,8	Quantum Mechnics	3	-	3 (3-0)	4,8
PIF21003	1,3,5,8	Quantum Optics	3	-	3 (3-0)	4,8
PIF21004	1,3,5,8	Quantum Information and Computation	3	-	3 (3-0)	4,8
PIF21005	1,3,6,9	Advance Computational Physics	3	-	3 (3-0)	4,8
PIF21006	1,3,4,5,9	Einstein Relativistic Teori	3	-	3 (3-0)	4,8
PIF21007	1,2,3,5,8	Statistical Mechanics	3	-	3 (3-0)	4,8
PIF21008	1,2,3,7,10	Advance Electronics	4	-	4 (3-1)	6,4
PIF21009	1,3,7,10	Signal Processing	2	-	2 (2-0)	3,2
PIF21010	1,2,7,3, 10	Sensor and Actuator System	3	-	3 (2-1)	4,8
PIF21011	1,3,7,9	Data Acquisition System	2	-	2 (2-0)	3,2
PIF21012	1,3,7,8	Electrical Circuit	3	-	3 (2-1)	4,8
PIF21013	1,2,3,7,10	Biosensor	2	-	2 (2-0)	3,2
PIF21014	1,3,5,7,9	Radiation Physics	2	-	2 (2-0)	3,2
PIF21015	1,2,3,5,7,8	Radiotherapy Physics	2	-	2 (2-0)	3,2
PIF21001	1,3,7,10	Medical and Nuclear Instrumentation	3	-	3 (3-0)	4,8
PIF21017	1,2,3,6,8	Medical Computation Physics	2	-	2 (2-0)	3,2
PIF21018	1,2,3,5,9	Biophysics	3	-	3 (3-0)	4,8
PIF21019	1,3,7,9	Gravity and Magnetics Method	2	1	3 (2-1)	4,8
PIF21020	1,3,7,8,10	Geoelectrical and electromagnetic Method	2	1	3 (2-1)	4,8
PIF21021	1,2,3,7,8	Geological Geophysics	2	1	3 (2-1)	4,8
PIF21022	1,3,7,8,10	Mapping and GIS	2	1	3 (2-1)	4,8
PIF21023	1,2,3,6,7,10	Environmental Geophysics	2	1	3 (2-1)	4,8
PIF21024	1,2,3,5,6,7, 10	Seismic Method	2	1	3 (2-1)	4,8
PIF21025	1,3,4,7,10	Seismology	3	-	3 (3-0)	4,8
PIF21026	1,3,7,10	Geothermal	2	-	2 (2-0)	3,2
PIF21027	1,2,3,6,7,10	Volcano Physics	2	-	2 (2-0)	3,2
PIF21028	1,3,5,8	Introduction to Meteorology	2	-	2 (2-0)	3,2

Course Code	PLO	Courses/Field of Study	Theory	Practice/ Practicum	SKS	ECTS
PIF21029	1,3,5,8	Material Physics	3	-	3 (3-0)	4,8
PIF21030	1,3,7,8,10	Biomaterial	2	-	2 (2-0)	3,2
PIF21031	1,3,7,8,9	Material Computational Physics	2	1	3 (2-1)	4,8
PIF21032	1,2,3,7,8,10	Composite Material	2	-	2 (2-0)	3,2
PIF21033	1,2,3,7,8,9	Thin Layer Technology	2	-	2 (2-0)	3,2
PIF21034	2,3,7,8,10	Membrane Technology	2	-	2 (2-0)	3,2
PIF21035	1,2,3,5,8	Material Characterization Method	3	-	3 (3-0)	4,8
PIF21036	1,2,3,5,8	Nano-Particle and dan Nano-technology	3	-	3 (3-0)	4,8
PIF21037	1,2,3,7,8,10	Material Synthesis Method	3	-	3 (3-0)	4,8
PIF21038	1,3,6,8	AI and Machine Learning	3	-	3 (3-0)	4,8
PIF21039	1,2,3,7,10	Embedded system and IOT	1	1	2 (1-1)	3,2
PIF21040	1,3,4,5,7,8, 9,10	Energy Physics	3	-	3 (3-0)	4,8
PIF21041	1,3,5,7,9	Environmental Physics	3	-	3 (3-0)	4,8
PIF21042	1,2,3,6,9	Kapita Selecta	2	-	2 (2-0)	3,2
PIF21043	1,2,3,10	English for Academic Purpose	3	-	3 (3-0)	4,8
MBKMXX		MBKM Courses outside the study program in the University			20	32
MBKMXY		MBKM Courses outside the study program outside the University			20	32

8. Course Organization of the Study Program

8.1. Relationship between Learning Outcomes, Study Materials, and Courses

The formation of courses and their assigned credit weights is essentially the culmination of the curriculum design process. In relation to the Learning Outcomes (PLO) assigned to each course, each study material that forms the basis of the course carries the PLO burden according to the following matrix.

Table 8.1. Matrix of the Relationship between PLO and Study Materials

Learning outcome		Study material																		
		Core													Supporting/Strengthening					
Domain (SN-Dikti)	PLO	Classical Mechanics	Thermodynamics	Termodinamika	Electricity and Magnetism	Waves	Modern Optics	Modern Physics	Statistical Physics	Nuclear Physics	Solid State Physics	Quantum Physics	Electronics & Instrumentation	Physics Experiments	Computation	Mathematics and Statistics	Earth Sciences	Language	Ethics and Personality	Data Analysis
Attitudes	S1 (PLO 1)		√	√					√								√		√	
	S2 (PLO 1)																		√	√

	S3 (PLO 1)			√		√	√										√	√	√
	S4 (PLO2)															√		√	√
	S5 (PLO 2)																√	√	√
	S6 (PLO 2)	√				√							√	√	√		√	√	√	√
	S7 (PLO 2)																		√	√
	S8 (PLO 2)	√	√	√	√	√	√	√	√	√	√		√	√	√		√	√	√	√
	S9 (PLO 1)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	S10 (PLO 2)	√	√	√	√	√	√	√	√	√	√	√			√				√	√
Knowledge	P1 (PLO 5)	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√			
	P2 (PLO 6)	√	√			√							√	√	√	√	√		√	√
	P3 (PLO 7)				√	√	√	√			√		√	√	√		√		√	√
Specific skills	KK1 (PLO 8)				√	√	√	√			√				√		√		√	√
	KK2 (PLO 8)	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√			
	KK3 (PLO 9)					√				√	√	√	√	√	√	√	√		√	√
	KK4 (PLO 10)			√		√	√	√		√	√		√	√	√		√			
	KK5 (PLO 10)				√	√					√						√	√	√	√
General skills	KU1 (PLO 3)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	KU2 (PLO 3)						√		√			√			√		√	√	√	√
	KU3 (PLO 3)				√	√	√	√							√		√		√	√
	KU4 (PLO 4)		√					√					√	√			√	√	√	√
	KU5 (PLO 4)																		√	√

In addition, regarding the process of achieving PLO through relevant courses based on the fields of study within the Physics Study Program, a matrix can be developed that relates PLO to each field of study within the Physics Study Program at the University of Mataram.

Table 8.2. Matrix of the Relationship between PLO and Fields of Study in the Physics Study Program

Learning outcomes		**Study material**			
Domain (SN-Dikti)	**PLO**	**Computational and Theoretical Physics**	**Materials**	**Instrumentation and Biophysics**	**Geophysics**
Attitudes	S1 (PLO 1)	S	L	L	S
	S2 (PLO 1)	L	L	L	L
	S3 (PLO 1)	L	S	L	S
	S4 (PLO2)	L	L	L	S
	S5 (PLO 2)	L	L	L	L
	S6 (PLO 2)	L	L	K	S
	S7 (PLO 2)	L	L	L	L
	S8 (PLO 2)	S	L	S	L
	S9 (PLO 1)	K	K	K	K
	S10 (PLO 2)	S	K	S	L
Knowledge	P1 (PLO 5)	K	S	S	S
	P2 (PLO 6)	S	L	S	S
	P3 (PLO 7)	L	K	K	K
Specific skills	KK1 (PLO 8)	L	S	L	K
	KK2 (PLO 8)	K	K	S	S
	KK3 (PLO 9)	S	S	S	S
	KK4 (PLO 10)	L	S	K	S

Learning outcomes		Study material			
Domain (SN-Dikti)	PLO	Computational and Theoretical Physics	Materials	Instrumentation and Biophysics	Geophysics
	KK5 (PLO 10)	L	S	K	K
General skills	KU1 (PLO 3)	S	K	K	K
	KU2 (PLO 3)	S	L	L	S
	KU3 (PLO 3)	S	S	S	K
	KU4 (PLO 4)	S	L	S	S
	KU5 (PLO 4)	L	L	L	L

Notes: K = Strong, S = Moderate, L = Weak

8.2. Course Structure within the Curriculum

The levels of knowledge in the field of Physics are described in the functional relationships of the study (Figure 6.1), which are organized into courses that form basic and supporting abilities, competencies in physics, which consist of theoretical, experimental, and computational competencies in the study program's courses. Furthermore, students have the opportunity to deeply explore the applied physics knowledge they wish to study, including courses in the fields of geophysics, theoretical and computational physics, material physics, instrumentation physics, and biophysics.

The courses that have been developed are organized into a course structure that clarifies the course selection planning process for students, both in the regular program and the Merdeka Belajar-Kampus Merdeka program. According to Table 8.3 and Table 8.4, there are 10 credits of university-required courses and 32 credits of faculty-required courses distributed across specific semesters. The study program courses amount to 80 credits (Table 8.5), and the specialized field courses total 22 credits.

Table 8.3. Mandatory University Courses (UU No. 12 of 2012, Article 35)

No.	Course Name	SKS		ECTS
A	**Basic Courses** (Law No. 12 of 2012, Article 35)			
1	Education of Religion	2		3,2
2	Pancasila	2		3,2
3	National Resilience	2		3,2
4	Indonesia Language	2		3,2
B	**Supporting of Basic Courses**			
1	Entrepreneurship	2		3,2
Number of SKS		**10**		**16**

Table 8.4. Mandatory Faculty Courses

No.	Course Name	SKS	ECTS
1	Fundamental Mathematics	4	6,4
2	Fundamental Physics	3	4,8
3	Fundamental Chemistry	3	4,8
4	Fundamental Biology	3	4,8
5	Practicum of Fundamental Physics	1	1,6
6	Practicum of Fundamental Chemistry	1	1,6
7	Practicum of Fundamental Biology	1	1,6
8	English Language	2	3,2
9	Research Methodology	2	3,2
10	Field Work	2	3,2
11	Community Services	4	6,4
12	Thesis	6	9,6
Number of SKS		**32**	**51,2**

Table 8.5. Study Program Courses

No.	Course Name	SKS	ECTS
1	Advanced Basic Physics	3 (3-0)	4,8
2	Practicum of Advanced Basic Physics	1 (0-1)	1,6
3	Statistics	3 (2-1)	4,8
4	Computer Programming	3 (2-1)	4,8
5	Mathematical Physics 1	4 (4-0)	6,4
6	Mathematical Physics 2	4 (4-0)	6,4
7	Numerical Methods	3 (3-0)	4,8
8	Thermodynamics	3 (3-0)	4,8
9	Classical Mechanics	4 (4-0)	6,4
10	Modern physics	3 (3-0)	4,8
11	Waves	3 (3-0)	4,8
12	Fundamental Electronics	4 (4-0)	6,4
13	Fundamental Electronics	4 (3-1)	6,4
14	Experimental Physics 1	2 (0-2)	3,2

No.	Course Name	SKS	ECTS
15	Experimental Physics 2	2 (0-2)	3,2
16	Instrumentation Physics	4 (3-1)	6,4
17	Computer Programming	3 (3-0)	4,8
18	Modern Optics	3 (3-0)	4,8
19	Statistical Physics	3 (3-0)	4,8
20	Solid state Physics	4 (4-0)	6,4
21	Nuclear Physics	3 (3-0)	
22	Quantum Physics	4 (4-0)	6,4
23	Introduction to Geophysics	3 (3-0)	4,8
24	Data Science	3 (3-0)	4,8
25	Scientific Articles Writing	2 (2-0)	3,2
26	Seminar	2 (2-0)	3,2
Number of SKS		**80**	**128**

The Bachelor's Program (Strata One-S1) requires a minimum of 144 credits to graduate; therefore, it is necessary to create a systematic structure that results in a hierarchy of knowledge aligned with the levels of understanding implied in each course. This systematic structure is presented in the course organization matrix. The course organization matrix for the Bachelor of Physics in the Physics Study Program, Faculty of Mathematics and Natural Sciences, University of Mataram, is shown in Figure 8.1 below.

Matriks Organisasi Mata Kuliah dalam Struktur Kurikulum Fisika 2021

SMT	SKS	JML MK	KELOMPOK MATAKULIAH PROGRAM STUDI FISIKA									
			MK Wajib									MK Pilihan
VIII	8	2							Pen. Artikel Ilmiah (2 sks)	Skripsi (6 sks)			
VII	15	3							Kerja Praktek (2 sks)	KKN (4 sks)			MKP Fisika (9 sks)
VI	20	4			Sains Data (Data Science) (3 sks)				Seminar (2 sks)	Kewirausahaan (2 sks)			MKP Fisika (13 sks)
V	21	7	Fisika Statistik (3 sks)	Optika Modern (3 sks)	Fisika Komputasi (3 sks)	Fisika Kuantum (4 sks)	Pengantar Geofisika (3 sks)	Fisika Inti (3 sks)	Metode Penelitian (2 sks)				
IV	20	6	Fisika Modern (3 sks)	Listrik Magnet (4 sks)	Instrumentasi Fisika (4 sks)	Gelombang (3 sks)	Fisika Eksperimen 2 (2 sks)	Fisika Zat Padat (4 sks)					
III	20	6	Termodinamika (3 sks)	Mekanika Klasik (4 sks)	Elektronika Dasar (4 sks)	Fisika Matematika 2 (4 sks)	Fisika Eksperimen 1 (2 sks)	Metode Numerik (3 sks)					
II	20	8	Statistika Dasar (3 sks)	Fisika Lanjutan (3 sks)	Pemrograman Komputer (3 sks)	Fisika Matematika 1 (4 sks)	Prak. FisDas Lanjutan (1 sks)			Bahasa Inggris (2 sks)	Pendidikan Agama (2 sks)	Pancasila (2 sks)	
I	20	9	Matematika Dasar (4 sks)	Fisika Dasar (3 sks)	Kimia Dasar (3 sks)	Prak. Kimdas (1 sks)	Prak. Fisdas (1 sks)	Biologi Dasar (3 sks)	Prak. Biodas (1 sks)		Bahasa Indonesia (2 sks)	Kewargane garaan (2 sks)	
	144												

ORGANISASI VERTIKAL (KEDALAMAN)

ORGANISASI HORISONTAL (KELUASAN)

MATA KULIAH WAJIB UNIVERSITAS
MATA KULIAH FAKULTAS
MATA KULIAH PROGRAM STUDI FISIKA
MATA KULIAH PEMINATAN (PILIHAN) PROGRAM STUDI FISIKA

Gambar 8.1. Courses organization matrix

9. Course Distribution List by Semester

Table 8.6 displays the course distribution for the undergraduate program (Bachelor's degree) in the Physics Study Program, Faculty of Mathematics and Natural Sciences (FMIPA), University of Mataram. The recognition of semester credit units (SKS) for each course is complemented with a conversion unit in the European Credit Transfer and Accumulation System (ECTS).

Table 8.6. Course Distribution by Semester

1st Year

No.	Course Code	Courses	Credits	
			SKS	ECTS
	SEMESTER I			
1	MKU21003	National Resilience	2	3,2
2	MKU21004	Indonesian Language	2	3,2
3	MKF21011	Fundamental Mathematics	4	6,4
4	MKF21007	Fundamental Physics	3	4,8
5	MKF21009	Fundamental Chemistry	3	4,8
6	MKF21005	Fundamental Biology	3	4,8
7	MKF21008	Practicum of Fundamental Physics	1	1,6

8	MKF21010	Practicum of Fundamental Chemistry	1	1,6
9	MKF21006	Practicum of Fundamental Biology	1	1,6
		Number of SKS	**20**	**32**
	SEMESTER II			
1	FIS21201	Advanced Basic Physics	3 (3-0)	4,8
2	FIS21205	Mathematical Physics 1	4 (4-0)	6,4
3	FIS21204	Computer Programming	3 (2-1)	4,8
4	FIS21203	Statistics	3 (2-1)	4,8
5	FIS21202	Practicum of Advanced Basic Physics	1 (0-1)	1,6
6	MKU21001	Education of Religion	2	3,2
7	MKU21002	Pancasila	2	3,2
8	MKF21012	English Language	2	3,2
		Number of SKS	**20**	**32**

2nd Year

No.	Course Code	Courses	Credits	
			SKS	ECTS
	SEMESTER III			
1	FIS21307	Classical Mechanics	4 (4-0)	6,4
2	FIS21308	Thermodynamics	3 (3-0)	4,8
3	FIS21309	Fundamental Electronics	4 (3-1)	6,4
4	FIS21306	Mathematical Physics 2	4 (4-0)	6,4
5	FIS21310	Experimental Physics 1	2 (0-2)	3,2
6	FIS21312	Numerical Methods	3 (3-0)	4,8
		Number of SKS	**20**	**32**
	SEMESTER IV			
1	FIS21413	Electromagnetism	4 (4-0)	6,4
2	FIS21414	Modern physics	3 (3-0)	4,8
3	FIS21415	Instrumentation Physics	4 (3-1)	6,4
4	FIS21416	Waves	3 (3-0)	4,8
5	FIS21411	Experimental Physics 2	2 (0-2)	3,2
6	FIS21417	Solid state Physics	4 (4-0)	6,4
		Number of SKS	**20**	**32**

3rd Year

No.	Course Code	Courses	Credits	
			SKS	ECTS
	SEMESTER V			
1	FIS21518	Statistical Physics	3 (3-0)	4,8
2	FIS21519	Computational Physics	3 (3-0)	4,8
3	FIS21520	Modern Optics	3 (3-0)	4,8
4	FIS21521	Nuclear Physics	3 (3-0)	4,8

5	FIS21522	Quantum Physics	4 (4-0)	6,4
6	MKF21001	Research Methodology	2 (2-0)	3,2
7	FIS21523	Introduction to Geophysics	3 (3-0)	4,8
		Number of SKS	**21**	**33,6**
	SEMESTER VI			
1	FIS21624	Data Science	3 (3-0)	4,8
2	FIS21625	Entrepreneurship	2 (2-0)	3,2
3	FIS21626	Seminar*	2 (2-0)	3,2
4	PIFxxxx	Elective Courses	13	20,8
		Number of SKS	**20**	**32**

4th Year

No.	Course Code	Courses	Credits	
			SKS	ECTS
	SEMESTER VII			
1	MKF21003	Community Services *	4 (4-0)	6,4
2	MKF21002	Field Work *	2 (2-0)	3,2
3	PIFxxxx	Elective Courses	9	14,4
		Jumlah	**15**	**24**
	SEMESTER VIII			
1	MKF21004	Thesis *	6 (6-0)	9,6
2	FIS21827	Scientific Articles Writing *	2 (2-0)	3,2
		Jumlah	**8**	**12,8**

* Can be scheduled in both the Odd and Even semesters.

Table 8.7. Elective Courses Within the Study Program

No.	Code	Courses	SKS	ECTS	Restriction
1	PIF21001	Electrodynamics	3 (3-0)	4,8	
2	PIF21002	Quantum Mechanics	3 (3-0)	4,8	
3	PIF21003	Quantum Optics	3 (3-0)	4,8	
4	PIF21004	Quantum Information and Computation	3 (3-0)	4,8	FIS21519
5	PIF21005	Advance Computational Physics	3 (3-0)	4,8	FIS21519
6	PIF21006	Einstein Relativistic Teori	3 (3-0)	4,8	
7	PIF21007	Statistical Mechanics	3 (3-0)	4,8	
8	PIF21008	Advance Electronics	4 (3-1)	6,4	
9	PIF21009	Signal Processing	2 (2-0)	3,2	
10	PIF21010	Sensor and Actuator System	3 (2-1)	4,8	
11	PIF21011	Data Acquisition System	2 (2-0)	3,2	
12	PIF21012	Electrical Circuit	3 (2-1)	4,8	
13	PIF21013	Biosensor	2 (2-0)	3,2	FIS21415

No.	Code	Courses	SKS	ECTS	Restriction
14	PIF21014	Radiation Physics	2 (2-0)	3,2	FIS21521
15	PIF21015	Radiotherapy Physics	2 (2-0)	3,2	
16	PIF21016	Medical and Nuclear Instrumentation	3 (3-0)	4,8	
17	PIF21017	Medical Computation Physics	2 (2-0)	3,2	
18	PIF21018	Biophysics	3 (3-0)	4,8	
19	PIF21019	Gravity and Magnetics Method	3 (2-1)	4,8	
20	PIF21020	Geoelectrical and electromagnetic Method	3 (2-1)	4,8	
21	PIF21021	Geological Geophysics	3 (2-1)	4,8	
22	PIF21022	Mapping and GIS	3 (2-1)	4,8	
23	PIF21023	Environmental Geophysics	3 (2-1)	4,8	
24	PIF21024	Seismic Method	3 (2-1)	4,8	
25	PIF21025	Seismology	3 (3-0)	4,8	
26	PIF21026	Geothermal	2 (2-0)	3,2	
27	PIF21027	Volcano Physics	2 (2-0)	3,2	
28	PIF21028	Introduction to Meteorology	2 (2-0)	3,2	
29	PIF21029	Material Physics	3 (3-0)	4,8	
30	PIF21030	Biomaterial	2 (2-0)	3,2	
31	PIF21031	Material Computational Physics	3 (2-1)	4,8	FIS21519
32	PIF21032	Composite Material	2 (2-0)	3,2	
33	PIF21033	Thin Layer Technology	2 (2-0)	3,2	
34	PIF21034	Membrane Technology	2 (2-0)	3,2	
35	PIF21035	Material Characterization Method	3 (3-0)	4,8	
36	PIF21036	Nano-Particle and dan Nano-technology	3 (3-0)	4,8	
37	PIF21037	Material Synthesis Method	3 (3-0)	4,8	
38	PIF21038	AI and Machine Learning	3 (3-0)	4,8	
39	PIF21039	Embedded system and IOT	2 (1-1)	3,2	
40	PIF21040	Energy Physics	3 (3-0)	4,8	
41	PIF21041	Environmental Physics	3 (3-0)	4,8	
42	PIF21042	Kapita Selecta	2 (2-0)	3,2	
43	PIF21043	English for Academic Purpose	3 (3-0)	4,8	MKF21012

No.	Code	Courses	SKS	ECTS	Restriction
44	MBKMXX	MBKM Courses outside the study program in the University	Max 20 sks	32	Conversion by Equivalence Team
45	MBKMXY	Courses at outside of the university (8 forms of MBKM learning activities, mechanisms in PDDikti related to operations)	Maks 40 sks	64	Conversion by Equivalence Team

Total Credits for Elective Courses Within the Study Program: 22 Credits

10. Semester Learning Plan (RPS)

The learning process plan for a course over one semester is outlined in the Semester Learning Plan (RPS). Each course RPS can use one or a combination of several learning methods as referred to in paragraph (3) and accommodated in a form of learning (Permendikbud No. 3 of 2020). Learning forms may include lectures, responses and tutorials, seminars, practicums, studio practice, workshop practice, field practice, internships, research, design, or development, military training, student exchanges, internships, entrepreneurship, and/or other forms of community service. Meanwhile, the learning methods used may include group discussions, simulations, case studies, collaborative learning, cooperative learning, project-based learning, problem-based learning, or other learning methods that can effectively facilitate the achievement of graduate learning outcomes.

The RPS in the Physics Study Program, FMIPA, University of Mataram is developed by lecturers, either independently or together in a group of expertise within a specific field of study in the Physics Study Program, University of Mataram. The RPS contains the following elements:

a. The name of the Study Program, the name and code of the course, semester, Credit Units (SKS), and the name of the lecturer in charge;
b. The Program Learning Outcomes assigned to the course (CPMK);
c. The final abilities planned at each stage of learning to meet the graduate learning outcomes;
d. The study materials related to the abilities to be achieved;
e. The learning methods;
f. The time allocated to achieve the abilities at each stage of learning;
g. The learning experiences of students as described in the assignments that must be completed by students throughout the semester;
h. The criteria, indicators, and weight of assessments; and
i. The list of references used.

The RPS for courses in the Physics Study Program in this curriculum is presented in the form of a Semester Learning Plan (RPS) document for courses in the Physics Study Program Curriculum 2021 (Format in Appendix).

11. Learning Assessment

The assessment of student learning outcomes can take the form of exam results and/or specific assessments such as for courses using case study methods. The principles of assessment include being educative, authentic, objective, accountable, and transparent, and are carried out in an integrated manner. Assessment techniques consist of observation, participation, performance, written tests, oral tests, and questionnaires (Rector Regulation of the University of Mataram No. 3 on the Academic Guidelines of the University of Mataram).

The assessment of student learning outcomes can take the form of exam results using the Criterion-Referenced Assessment (CRA) system, which is a model of assessment that refers to criteria in achieving the learning objectives previously set. For assessments using tests (exams), the calculation of the final grade (NA) is as follows:

1. For courses without practical components:

$$NA = \frac{20U_1 + 30U_2 + 50U_3}{100}$$

2. For courses with practical components:

$$NA = \left(S_p \times P + S_k \times \left(\frac{20U_1 + 30U_2 + 50U_3}{100} \right) \right) \frac{1}{S_p + S_k}$$

where U_1 = assignment/quiz grade; U_2 = mid-semester exam grade; U_3 = final exam grade; P = practical grade; S_p = practical credit units; S_k = lecture credit units.

For courses using the case method, the calculation of the final grade uses the following competency standards:

1. Attitude competency (K1), assessment is carried out through observation, self-assessment, peer assessment (performance assessment), and assessment of ethical behavior aspects (emphasizing aspects of faith, moral integrity, self-confidence, discipline, and responsibility in effectively interacting with the social environment, nature, the world, and civilization).
2. Knowledge competency (K2), carried out through written and oral tests.
3. Skill competency (K3), through performance assessment, which can be conducted through practicums, practices, simulations, field practices, and other activities that allow students to improve their skills.

The calculation of the final grade (NA) is as follows:

1. For courses without practical components:

$$NA = \frac{20NK_1 + 30NK_2 + 50NK_3}{100}$$

2. For courses with practical components:

$$NA = \left(S_p \times P + S_k \times \left(\frac{20NK_1 + 30NK_2 + 50NK_3}{100}\right)\right)\frac{1}{S_p + S_k}$$

where K_1 = average attitude competency grade; K_2 = average knowledge competency grade; K_3 = average skill competency grade; P = practical grade; S_p = practical credit units; S_k = lecture credit units.

12. Implementation Plan for the Right to Study Up to 3 Semesters Outside the Study Program

The Ministry of Education and Culture Regulation Number 3 of 2020 concerning National Standards for Higher Education states that universities must facilitate the right for students (whether they choose to exercise it or not) to study outside their Study Program or University for up to 3 semesters, which includes:

1. Students may take credits outside the university for up to 2 semesters or equivalent to 40 credits.
2. Students may take credits in a different study program within the same university for 1 semester or equivalent to 20 credits.

The provisions provided by the Ministry of Education and Culture Regulation No. 3 of 2020 regarding the right to study outside the Study Program include the following learning schemes:

a. Learning in another Study Program at the same University;
b. Learning in the same Study Program at a different University;
c. Learning in another Study Program at a different University; and
d. Learning at a non-University institution.

In accordance with the mandate of the Ministry of Education and Culture Regulation No. 3 of 2020, the Department of Physics has developed an implementation plan for the Freedom to Learn - Independent Campus (MBKM) program within the 2021 curriculum as follows:

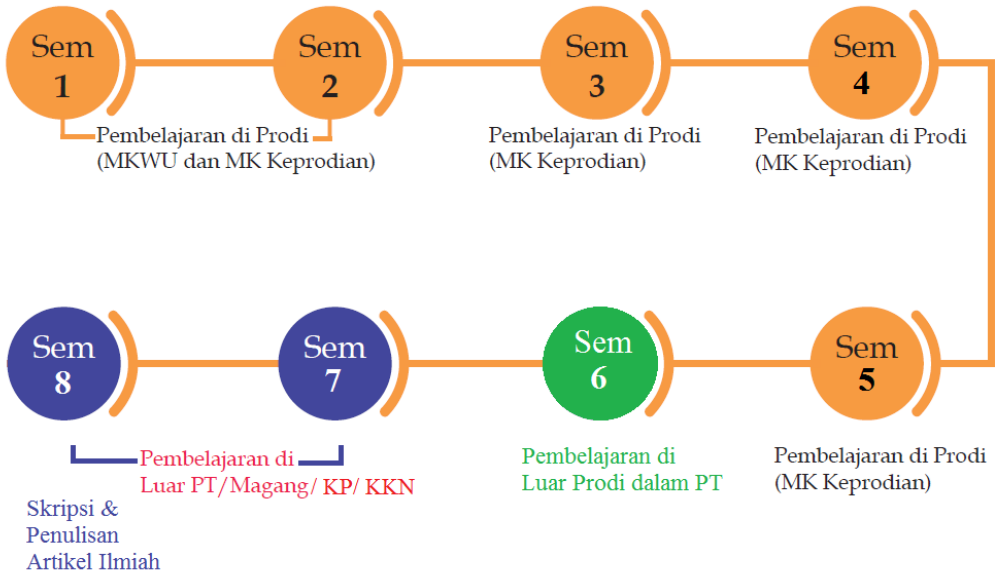

Figure 12.1. Implementation of the Freedom to Learn Program in the Department of Physics, Faculty of Mathematics and Natural Sciences, University of Mataram.

The matrix of course organization within the 2021 Physics Curriculum structure with the MBKM Program is described in Figure 12.2.

Program Pembelajaran Matakuliah Kurikulum Fisika 2021

SMT	SKS	PROGRAM PEMBELAJARAN DALAM PROGRAM STUDI FISIKA														PROGRAM MBKM		
		Matakuliah Program Studi							MK Pilihan	Matakuliah Fakultas dan Perguruan Tinggi						Dalam PT	PT Lain	Non PT
VIII	8							Pen. Artikel Ilmiah (2 sks)		Skripsi (6 sks)								MBKM
VII	15							Kerja Praktek (2 sks)	MKP Fisika (9 sks)	KKN (4 sks)							MBKM	MBKM
VI	20			Sains Data (Data Science) (3 sks)				Seminar (2 sks)	MKP Fisika (13 sks)	Kewirausahaan (2 sks)						MBKM		
V	21	Fisika Statistik (3 sks)	Optika Modern (3 sks)	Fisika Komputasi (3 sks)	Fisika Kuantum (4 sks)	Pengantar Geofisika (3 sks)	Fisika Inti (3 sks)	Metode Penelitian (2 sks)										
IV	20	Fisika Modern (3 sks)	Listrik Magnet (4 sks)	Instrumentasi Fisika (4 sks)	Gelombang (3 sks)	Fisika Eksperimen 2 (2 sks)	Fisika Zat Padat (4 sks)											
III	20	Termodinamika (3 sks)	Mekanika Klasik (4 sks)	Elektronika Dasar (4 sks)	Fisika Matematika 2 (4 sks)	Fisika Eksperimen 1 (2 sks)	Metode Numerik (3 sks)											
II	20	Statistika Dasar (3 sks)	Fisika Lanjutan (3 sks)	Pemrograman Komputer (3 sks)	Fisika Matematika 1 (4 sks)	Prak. FisDas Lanjutan (1 sks)				Bahasa Inggris (2 sks)				Pendidikan Agama (2 sks)	Pancasila (2 sks)			
I	20	Matematika Dasar (4 sks)	Fisika Dasar (3 sks)			Prak. Fisdas (1 sks)				Kimia Dasar (3 sks)	Biologi Dasar (3 sks)	Prak. Kimdas (1 sks)	Prak. Biodas (1 sks)	Bahasa Indonesia (2 sks)	Kewargane garaan (2 sks)			
	144																	

MATA KULIAH WAJIB PT (Undang-Undang No. 12 Tahun 2012, Pasal 35)
MATA KULIAH FAKULTAS
MATA KULIAH PROGRAM STUDI FISIKA
MATA KULIAH PEMINATAN (PILIHAN) PROGRAM STUDI FISIKA

Figure 12.2. Physics Curriculum Matrix of the Faculty of Mathematics and Natural Sciences, University of Mataram, with the MBKM Program..

Learning activities conducted outside the study program can receive recognition for a maximum of 20 credits (Table 12.1 and Table 12.2) based on the conversion and equivalency results conducted by the equivalency team formed by the Faculty of Mathematics and Natural Sciences, University of Mataram.

Table 12.1. Courses for the MBKM Program Outside the Study Program Within the University (MBKM Program)

No.	CODE	COURSES	SKS	Restriction
1 dst.	MBKMXX	MBKM Courses outside the Study Program within the University	Max 20 sks	Conversion by the Equivalency Team

Table 12.2. Courses for the MBKM Program Outside the University (MBKM Program)

No.	CODE	COURSES	SKS	Restriction
1 dst.	MBKMXY	MBKM Courses outside the Study Program outside the University	Max 20 sks	Conversion by the Equivalency Team

For learning activities outside the university, students can participate in accordance with the eight types of learning activities of the MBKM program (Figure 12.3) with recognition of 20 credits.

Figure 12.3. The Eight Types of Learning Activities Outside the University

Table 12.3. Description of 8 Forms of Learning Activities Outside the University

No.	Activities	Description
1	Internship/Work Practice	A 1-2 semester internship program providing students with substantial experience, offering direct learning at the workplace (experiential learning). During the internship, students will gain hard skills (skills, complex problem-solving, analytical skills, etc.), as well as soft skills (professional/work ethics, communication, teamwork, etc.).
2	Village Project	A form of learning experience where students live within a community outside the campus, working with the community to identify potentials and address problems, with the aim of developing the village/region's potential and finding solutions to existing issues.
3	Teaching in Schools	A learning activity in the form of teaching assistance that students can undertake in educational institutions such as elementary, middle, or high schools. The location of the schools can be in urban or remote areas.
4	Student Exchange	Attending classes or semesters at universities abroad or within the country, based on agreements established by the Government. Several types of learning activities that can be carried out within the framework of student exchange include: Student Exchange between Study Programs at the Same University; Student Exchange in the Same Study Program at Different Universities; Student Exchange between Study Programs at Different Universities.
5	Research	A research activity at a research institute/study center where students acquire research competencies through direct mentoring by researchers at the institution.
6	Entrepreneurship Activities	The development of students' entrepreneurial interests through a learning program aimed at fostering and guiding their business ventures early on.
7	Independent Study/Project	An education activity based on research and development aimed at realizing innovative products of their ideas. Independent project activities can be carried out in the form of cross-disciplinary group work.

8	Humanitarian Projects	Involvement of students in humanitarian programs and other development projects both in Indonesia and abroad.

Source: Merdeka Belajar Kampus Merdeka Guidebook, 2020.

From the eight types of Merdeka Belajar Kampus Merdeka (MBKM) learning activities, the alignment of learning activities must support the completion of studies and the achievement of learning outcomes in the Physics program. These MBKM learning activities can be planned by students starting from semesters 6, 7, and/or 8, depending on the preferred pathway. The role of academic advisors is crucial in guiding students to choose the pathways or courses offered. The following Table 12.4 shows the conversion/equivalence of 4 MBKM learning activities with a recognition of 20 credits in the Physics program curriculum at the University of Mataram.

Table 12.4. Conversion/Equivalence of 4 MBKM Learning Activities with Recognition of 20 Credits

No	KODE	MATA KULIAH	SKS	Keterangan
A.	**Studi Independen**			
		• Studi independen (Pilihan bidang kajian yang terkait dengan matakuliah yang beririsan)	(Konversi Tim Ekuivalensi)	
		Total	20 (SKS)	SKS Maks
B.	**Program Magang**			
		• Kerja Praktek	2	
		• Seminar	2	
		• Pilihan bidang kajian yang terkait dengan tempat tujuan magang (matakuliah yang beririsan)	16 Maks. (Konversi Tim Ekuivalensi)	
		• *Softskill*	SKPI	
		Total	20 (SKS)	SKS Maks
C.	**Program Riset**			
		• Skripsi	6	
		• Seminar	2	
		• Penulisan artikel Ilmiah	2	
		• Matakuliah Pilihan bidang kajian yang terkait yang beririsan	10	
		Total	20 (SKS)	SKS Maks.

D.	**KKN (Program KKN Tematik)**			
		• KKN	4	
		• Skripsi	6	
		• Penulisan artikel Ilmiah	2	
		• Seminar	2	
		• Matakuliah Pilihan bidang yang beririsan	6	
		Total	20 (SKS)	SKS Maks.

The equivalence recognition of 20 credits for other MBKM learning activities can be determined by the equivalence team of the Faculty of Mathematics and Natural Sciences (FMIPA) at the University of Mataram. For soft skills and other competencies obtained by students through MBKM activities that cannot be equivalently converted into a course within the curriculum, they will be listed in the Diploma Supplement (SKPI). SKPI (Surat Keterangan Pendamping Ijazah) is an official statement issued by the university that contains information about the academic achievements or qualifications of higher education graduates. The qualifications of graduates are narrated descriptively, stating the learning outcomes of graduates at the relevant KKNI level, in a standard format that is easily understood by the general public (Permendikbud No. 59 of 2018).

13. Curriculum Implementation Management and Mechanism

13.1. Curriculum Implementation Plan

The curriculum that has been developed is the 2021 curriculum (MBKM Curriculum for the Physics Study Program 2021). The implementation of this curriculum will be enforced in the odd semester of the 2021-2022 academic year. The implementation of the Merdeka Belajar Kampus Merdeka (MBKM) program activities is regulated in the MBKM implementation guidelines.

The Semester Learning Plan (RPS) and Student Task Plan must be prepared and finalized before the learning process begins for a semester. The RPS and RTM that are created must refer to the applicable curriculum, as these documents provide direction and guidance on how the learning process should be conducted and how learning evaluations should be carried out in order to achieve the expected learning outcomes through the courses offered by the Physics Study Program.

13.2. Internal Quality Assurance System (SPMI) Tools

The curriculum quality assurance system for curriculum development and implementation follows the 4-step PDCA (Plan-Do-Check-Act) cycle as described in Figure 13.1.

Figure 13.1. Curriculum Development and Implementation in accordance with SN-Dikti (Junaidi, et al. 2020)

The 4-step PDCA cycle is as follows:

1. Plan: Develop a plan (learning outcomes, lesson design), or identify problems or weaknesses in the learning tools and find solutions to address these issues.
2. Do: Implement the plan that has been developed.
3. Check: Assess and evaluate the achievement of PLO-Study Program, identify what has been implemented, and find deficiencies encountered and plan for improvements.
4. Act: Make improvements to the tools and learning processes.

The curriculum implementation quality assurance system in the Physics Study Program is based on the quality assurance system developed by the Quality Assurance and Educational Development Institute (LPMPP) of the University of Mataram and the Quality Assurance Group (GPM) of the Faculty of Mathematics and Natural Sciences (FMIPA), which is outlined in the FMIPA quality standards document. The SPMI system tools used by the Physics Study Program include:

1. The FMIPA SPMI standards document for education, which contains eight standards: (1) graduate competency standards, (2) content standards, (3) process standards, (4) assessment standards, (5) educator and staff standards, (6) infrastructure standards, (7) management standards, (8) financing standards.

2. Course Portfolio Completeness Documents, which include the Semester Learning Plan (RPS) for Courses, Attendance Sheets for Lecturers and Students, OBE: Report on the Achievement of Overall Learning Outcomes for Courses (CPMK) (Appendix 2).
3. SOP/Guidelines for Implementing the MBKM Curriculum for the Physics Study Program (Appendix).

14. Conclusion

The alignment of the curriculum in the Physics Study Program is the result of an evaluation of the 2016 KKNI Curriculum, starting from the Program Study Vision, which has been elaborated according to Permendikbud No. 3 of 2020. The addition of new courses aims to strengthen graduates' competencies in line with the skills required in the era of Industry 4.0, the adjustment of teaching methods, and the implementation of the Merdeka Belajar-Kampus Merdeka program, which offers opportunities for learning outside the study program to enhance the quality of graduates from the Physics Study Program.

With the implementation of this curriculum, adjustments to the learning system will follow the established policies. The implementation of this curriculum is expected to improve the quality of graduates produced by the Physics Study Program, Faculty of Mathematics and Natural Sciences, University of Mataram, making them competitive and adaptable in the era of Industry 4.0 and Society 5.0.

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Permendikbud No. 22 tahun 2020, tentang Rencana Strategis Kementerian Pendidikan dan Kebudayaan.

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Keputusan Rektor Nomor 4476/UN.18/HK/2021 tentang Penetapan Panduan Rekognisi/Pengakuan Kegiatan Kemahasiswaan Menjadi Satuan Kredit Semester Unram.

Lampiran: Template 1. Rencana Pembelajaran Semester (RPS)

	UNIVERSITAS MATARAM **FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM** **PROGRAM STUDI FISIKA**	**Kode Dokumen**

RENCANA PEMBELAJARAN SEMESTER (RPS)

Nama Mata Kuliah	**Kode Mata Kuliah**	**Bobot (sks)**	**Semester**	**Tgl Penyusunan**	**Tgl Revisi**

Otorisasi/Pengesahan	**Nama Koordinator PengembangRPS**	**Koordinator Bidang Keahlian (Jika Ada)**	**Ketua Program Studi**
	Tanda tangan Nama Terang	Tanda tangan Nama Terang	Tanda tangan Nama Terang

Capaian Pembelajaran (CP)	**PLO-Program Studi (Capaian Pembelajaran Lulusan Program Studi) yang Dibebankan pada Mata Kuliah**	
	PLO1	
	PLO2	
	PLO3	
	……..	
	PLOn	
	Capaian Pembelajaran Mata Kuliah (CPMK)	

	CPMK1					
	CPMK2					
	CPMK3					
	……..					
	CPMKn					
Capaian Pembelajaran (CP)	**Kemampuan Akhir tiap tahapan belajar (Sub-CPMK)**					
	Sub-CPMK1					
	Sub-CPMK2					
	Sub-CPMK3					
	……..					
	Sub-CPMKn					
	Korelasi CPMK terhadap Sub-CPMK					
		Sub-CPMK1	**Sub-CPMK2**	**Sub-CPMK3**	……..	**Sub-**CPMKn
	CPMK1					
	CPMK2					
	…….					
	CPMKn					
Diskripsi Singkat Mata Kuliah						
Bahan Kajian: Materi pembelajaran						

Pustaka	**Utama:**
	1. 2. 3. 4. 5.
	Pendukung:
	6. 7. 8. N
Dosen Pengampu	
Mata kuliah prasyarat (jika ada)	

Contoh: Analisis Pembelajaran

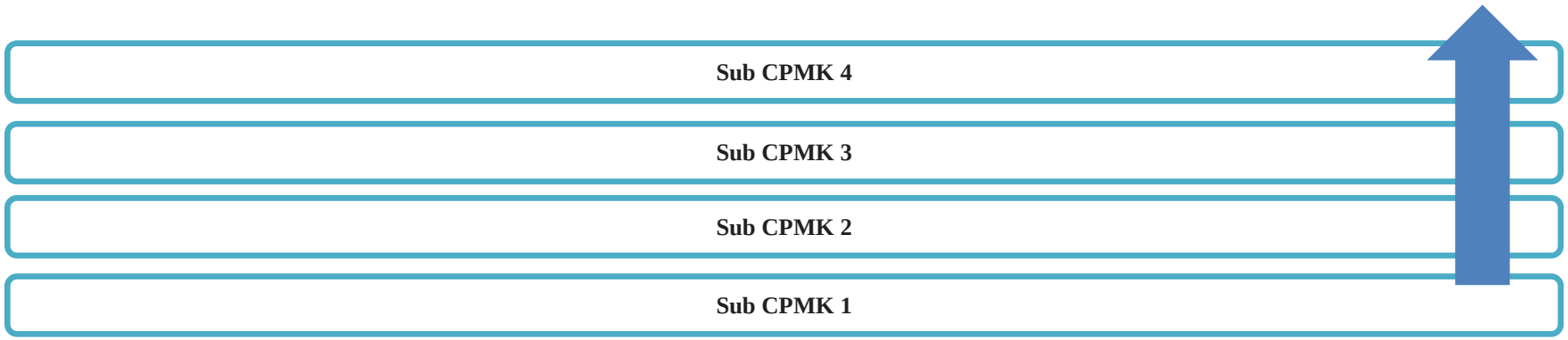


Diagram Analisis Pembelajaran Mata Kuliah Listrik Magnet

Rencana Pembelajaran Semester

Minggu Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; (Estimasi Waktu)		Materi Pembelajaran	Bobot Penilaian	Daftar Rujukan
		Indikator	Teknik dan Kriteria	Luring	Daring			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1 2 ,,,,,, 16								

Catatan:

1. Capaian Pembelajaran Lulusan Program Studi (PLO-Prodi) adalah kemampuan yang dimiliki oleh setiap lulusan Prodi yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
2. PLO yang dibebankan pada mata kuliah adalah beberapa capaian pembelajaran lulusan program studi (PLO-Prodi) yang digunakan untuk pembentukan/pengembangan sebuahmata kuliah yang terdiri dari aspek sikap, pengetahuan, ketrampulan umum, ketrampilan khusus.
3. CP Mata kuliah (CPMK) adalah kemampuan yang dijabarkan secara spesifik dari PLO yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materipembelajaran mata kuliah tersebut.
4. Sub-CP Mata kuliah (Sub-CPMK) adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.

5. Indikator penilaian kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajarmahasiswa yang disertai bukti-bukti.
6. Kreteria Penilaian adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kreteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kreteria dapat berupa kuantitatif ataupun kualitatif.
7. Teknik penilaian: tes (tertulis, lisan) dan non tes (observasi, unjuk kerja, portofolio, dan lainya)
8. Bentuk pembelajaran: Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, PraktikLapangan, Penelitian, Pengabdian Kepada Masyarakatdan/atau bentuk pembelajaran lain yang setara.
9. Metode Pembelajaran: Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, Case-based Learning, dan metode lainnya yg setara.
10. Materi Pembelajaran adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok bahasan dan sub-pokok bahasan.
11. Bobot penilaian adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb. Minimal 50% dari total 100% bobot nilai terbentuk dari pembelajaran berbasis kasus dan/atau berbasis project.
12. Daftar rujukan cukup ditulis nomor Pustaka yang digunakan sebagai rujukan untuk setiap materi pembelajaran.
13. Bentuk Pembelajaran 1 (satu) Satuan Kredit Semester pada proses Pembelajaran setara dengan 170 menit per minggu per semester

Minggu Ke-	Kemampuan akhir tiap tahapan belajar (Sub-CPMK)	Penilaian		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; (Estimasi Waktu)		Materi Pembelajaran	Bobot Penilaian	Daftar Rujukan
		Indikator	Kriteria dan Teknik	Luring	Daring			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
##	Sub-CP Mata kuliah (Sub-CPMK) adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.	Indikator penilaian kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.	* Kreteria Penilaian adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. * Kreteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan	**Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.	Diisi sesuai kegiatan melalui jaringan internet, seperti diskusi melalui SPADA atau media lain	Materi Pembelajaran adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok bahasan dan sub-pokok bahasan.	Bobot penilaian adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proporsional dengan tingkat kesulitan pencapaian sub-CPMK tsb. Minimal 50% dari total 100% bobot nilai terbentuk dari pembelajaran berbasis kasus dan/atau berbasis	Nomor referensi

			tidak bias. * Kreteria dapat berupa kuantitatif ataupun kualitatif. * Teknik penilaian: tes (tertulis, lisan) dan non tes (observasi, unjuk kerja, portofolio, dan lainya)	**Metode** Pembelajaran: *Small Group Discussion*, *Role-Play & Simulation*, *Discovery Learning*, *Self-Directed Learning*, *Cooperative Learning*, *Collaborative Learning*, *Contextual Learning*, *Project Based Learning*, *Case-Based Learning*, dan metode lainnya yang setara.			project.	

1, 2	Mampu menjelaskan tentang pengetahuan, ilmu, filsafat dan etika dan plagiasi dalam penelitian (C2, A3)	1. Ketepatan menjelaskan tentang pengetahuan, ilmu dan filsafat; 2. Ketepatan menjelaskan pengertian etika dalam penelitian; 3. Ketepatan menjelaskan pengertian plagiasi, mencegah plagiasi, dan konsekuensi tindakan plagiasi.	**Kriteria**: Pedoman penskoran (*Marking scheme*); **Teknik**: Non-test Meringkas Materi kuliah	**Kuliah**: • **Diskusi kelas** (2x50 menit) • **Tugas 1** (4x60 menit): Menyusun ringkasan dalam bentuk makalah tentang pengertian pengetahuan, ilmu dan filsafat beserta contohnya.	• Review video pembelajaran • Diskusi eLearning: https://spada.unram.ac.id	Pengertian pengetahuan, ilmu dan filsafat, pendekatan ilmiah dan non-ilmiah, tugas ilmu dan penelitian.	10	(6) hlm: 10-40
				Kuliah: • **Diskusi kelompok** (2x50 menit) • **Tugas 1** (4x60 menit): Menyusun makalah studi kasus tentang etika dalam penelitian	• Unggah makalah pada e-learning • Diskusi e-Learning: https://spada.unram.ac.id			

				terkait dengan plagiasi.				
9, 10	Mampu memilih, menetapkan, dan menjelaskan teknik mengolah data sampel penelitian dengan sistematis, bermutu, dan terukur (C3, A3)	1. Ketepatan menjelaskan perbedaan populasi dan sampel; 2. Ketepatan menjelaskan berbagai teknik penentuan sampel; 3. Ketepatan menentukan jumlah sampel: 4. Ketepatan teknik pengolahan data.	**Kriteria:** Berdasarkan rubrik deskriptif); **Teknik Non Tes:** Penilaian dokumen penentuan sampel penelitian	• **Kuliah:** • **Studi Kasus** (2x50 menit) • **Tugas 7** (studi kasus): Memilih dan mendesain sampel penelitian, serta teknik mengolah data sampel. (2+2)x(2x60 menit)	• Unggah makalah pada e-learning • Diskusi eLearning: https://spada.unram.ac.id	Terminologi sampel penelitian, jenis data, alasan pemilihan sampel, karakteristik sampel, teknik penentuan sampel, dan tenkik pengolahan data sampel penelitian.	15	(1) hlm: 140-264 (2) hlm: 119-266 (5) hlm: 29-280

Catatan:

1. Capaian Pembelajaran Lulusan Program Studi (PLO-Prodi) adalah kemampuan yang dimiliki oleh setiap lulusan Prodi yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
2. PLO yang dibebankan pada mata kuliah adalah beberapa capaian pembelajaran lulusan program studi (PLO-Prodi) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, pengetahuan, ketrampulan umum, ketrampilan khusus.
3. CP Mata Kuliah (CPMK) adalah kemampuan yang dijabarkan secara spesifik dari PLO yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.

4. Sub-CP Mata kuliah (Sub-CPMK) adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.
5. Indikator penilaian kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
6. Kriteria penilaian adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
7. Teknik penilaian: tes (tertulis, lisan) dan non tes (observasi, unjuk kerja, portofolio, dan lainya)
8. Bentuk pembelajaran: Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
9. Metode Pembelajaran: *Small Group Discussion*, *Role-Play* & *Simulation*, *Discovery Learning*, *Self-Directed Learning*, *Cooperative Learning*, *Collaborative Learning*, *Contextual Learning*, *Project Based Learning*, *Case-Based Learning*, dan metode lainnya yang setara.
10. Materi Pembelajaran adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok bahasan dan sub-pokok bahasan.
11. Bobot penilaian adalah persentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tersebut. Minimal 50% dari total 100% bobot nilai terbentuk dari pembelajaran berbasis kasus dan/atau berbasis project.
12. Daftar rujukan cukup ditulis nomor Pustaka yang digunakan sebagai rujukan untuk setiap materi pembelajaran.
13. Bentuk Pembelajaran 1 (satu) Satuan Kredit Semester pada proses pembelajaran setara dengan 170 menit per minggu per semester.

Contoh: Rencana Pembelajaran Semester

ANALISIS PEMBELAJARAN / PETA CAPAIAN PEMBELAJARAN MATA KULIAH ELEKTRONIKA DASAR

CPMK Elektronika Dasar: 1) Menguasai metode-metode dan prinsip-prinsip dasar dalam bidang elektronika, 2) Mampu menganalisis solusi permasalahan terkait di bidang elektronika dengan menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam analisis secara bertanggung jawab, 3). Mampu merancang, membuat, dan menganalisis suatu rangkaian elektronika secara mandiri

EVALUASI AKHIR SEMESTER (MINGGU KE-16)

Sub CPMK 12 : Mampu menguraikan konsep dasar elektronika digital

Sub CPMK 11 : Mampu menganalisis rangkaian filter aktif dan osilator dalam suatu rangkaian elektronika

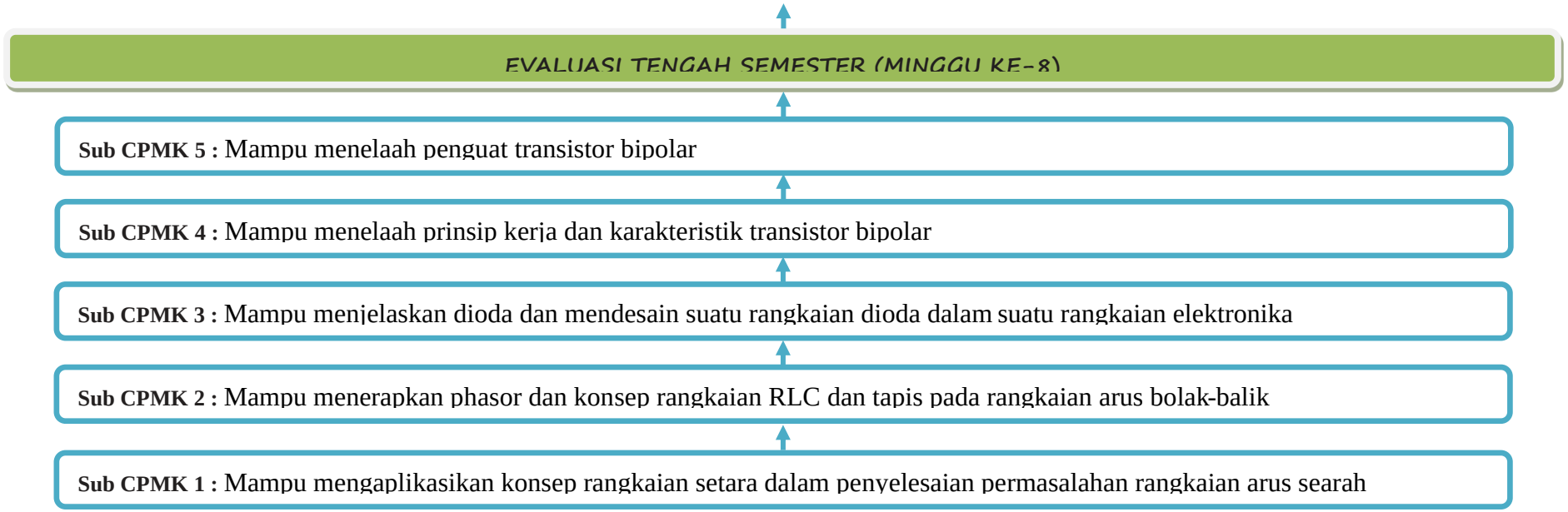
Sub CPMK 10 : Mampu menganalisis dan merancang suatu rangkaian op-amp

Sub CPMK 9 : Mampu menjelaskan karakteristik rangkaian penyusun penguat operasional (op-amp)

Sub CPMK 8 : Mampu menganalisis suatu penguat differensial dalam suatu rangkaian elektronika

Sub CPMK 7 : Mampu menganalisis prinsip kerja MOSFET dan penerapannya

Sub CPMK 6 : Mampu menguraikan prinsip kerja JFET dan penerapannya


EVALUASI TENGAH SEMESTER (MINGGU KE-8)
Sub CPMK 5 : Mampu menelaah penguat transistor bipolar
Sub CPMK 4 : Mampu menelaah prinsip kerja dan karakteristik transistor bipolar
Sub CPMK 3 : Mampu menjelaskan dioda dan mendesain suatu rangkaian dioda dalam suatu rangkaian elektronika
Sub CPMK 2 : Mampu menerapkan phasor dan konsep rangkaian RLC dan tapis pada rangkaian arus bolak-balik
Sub CPMK 1 : Mampu mengaplikasikan konsep rangkaian setara dalam penyelesaian permasalahan rangkaian arus searah

Universitas Mataram
Fakultas Matematika dan Ilmu Pengetahuan Alam
Program Studi Fisika

RENCANA PEMBELAJARAN SEMESTER

MATA KULIAH	KODE	BOBOT (sks)		SEMESTER	Tgl Penyusunan
Elektronika Dasar	FIS21309	T = 3	P =1	3	21 Juni 2021
OTORISASI/PENGESAHAN	**Dosen Pengembang RPS**		**Koordinator Bidang Keahlian**	**Ketua Program Studi**	
	Dr. Rahadi Wirawan, S.Si., M.Si. & Arif Budianto, M.Si.		Dr. Rahadi Wirawan, S.Si., M.Si.	Dr. Rahadi Wirawan, S.Si., M.Si.	

Capaian Pembelajaran	**Capaian Pembelajaran Program Studi yang dibebankan pada Mata Kuliah**	
	PLO 1	Mampu menunjukkan sikap religius dan mengamalkan nilai-nilai Pancasila dalam menjalankan tugas dan tanggung jawab yang berkontribusi pada peningkatan kualitas kehidupan bermasyarakat, berbangsa dan bernegara.
	PLO 3	Mampu melakukan kajian berdasarkan pemikiran logis, kritis, sistematis, inovatif dan mampu memformulasikan serta mengimplementasikan hasil kajian dalam konteks penyelesaian masalah sesuai dengan bidang keahliannya.
	PLO 6	Menguasai metode-metode matematika, komputasi dan instrumentasi dalam fisika.
	PLO 8	Mampu merumuskan gejala dan masalah fisis melalui analisis berdasarkan hasil observasi dan eksperimen dan menyusun model matematis atau model fisis yang sesuai.
	PLO 9	Mampu menganalisis berbagai solusi alternatif yang ada terhadap permasalahan fisis dan menyimpulkannya untuk pengambilan keputusan yang tepat.
	Capaian Pembelajaran Mata Kuliah (CPMK)	
	CPMK 1	Menguasai metode dan prinsip dasar dalam bidang elektronika (PLO 1, PLO 3)
	CPMK 2	Menguasai analisis solusi permasalahan di bidang elektronika secara logis, kritis, sistematis, dan inovatif (PLO 3, PLO 6)
	CPMK 3	Mampu merancang dan membuat rangkaian elektronika secara mandiri (PLO 8)
	CPMK 4	Mampu menganalisis rangkaian elektronika secara mandiri (PLO 9)
	Kemampuan Akhir tiap tahapan belajar (Sub-CPMK)	

	Sub-CPMK1	Mampu mengaplikasikan konsep rangkaian setara dalam permasalahan rangkaian arus (C3, A4) (CPMK 1)
	Sub-CPMK2	Mampu menerapkan phasor dan konsep rangkaian RLC dan Tapis pada rangkaian arus bolak-balik (C3, A4)
	Sub-CMPK3	Mampu menjelaskan dioda dan mendesain suatu rangkaian dioda dalam suatu rangkaian elektronika (C1, A1)
	Sub-CPMK4	Mampu menuliskan prinsip kerja dan karakteristik transistor bipolar (C1, A1) (CPMK 1) (CPMK 2)
	Sub-CPMK5	Mampu menelaah penguat transistor bipolar (C4, A4) (CPMK 1) (CPMK 2)
	Sub-CPMK6	Mampu menyelesaikan prinsip kerja JFET dan penerapannya (C4, A4) (CPMK 1) (CPMK 2) (CPMK3)
	Sub-CPMK7	Mampu menganalisis prinsip kerja MOSFET dan penerapannya (C4, A4) (CPMK 1) (CPMK 2) (CPMK3)
	Sub-CPMK8	Mampu menganalisis suatu penguat diferensial dalam suatu rangkaian elektronika (C4, A4) (CPMK 1) (CPMK 2)
	Sub-CPMK9	Mampu menjelaskan karakteristik rangkaian penyusun penguat operasional (C4, A4) (CPMK 1) (CPMK 2)
	Sub-CPMK10	Mampu menganalisis dan merancang suatu rangkaian op-amp (C4, A4) (CPMK 1) (CPMK 2) (CPMK 3)
	Sub-CPMK11	Mampu menganalisis rangkaian filter aktif dan osilator dalam rangkaian elektronika (C4, A4) (CPMK 1) (CPMK
	Sub-CPMK12	Mampu menganalisis konsep dasar elektronika digital (C4, A4) (CPMK 1) (CPMK 2) (CPMK 3) (CPMK4)

Korelasi CPMK terhadap sub-CPMK

	Sub CPMK1	Sub CPMK2	Sub CPMK3	Sub CPMK4	Sub CPMK5	Sub CPMK6	Sub CPMK7	Sub CPMK8	Sub CPMK 9	Sub CPMK10	Sub CPMK11	Sub CPMK12
CPMK1	√	√	√	√	√	√	√	√	√	√	√	√
CPMK2	√	√	√	√	√	√	√	√	√	√	√	√
CPMK3						√	√	√	√	√	√	√
CPMK4									√	√	√	√

Deskripsi singkat Mata Kuliah	Mata kuliah ini merupakan mata kuliah wajib berbobot 4 SKS, di mana mahasiswa diperkenalkan dengan teorema penyederhanaan rangkaian analog (seperti Thevenin, Norton, superposisi), rangkaian arus bolak-balik, komponen elektronika aktif dan pasif semikonduktor, aneka jenis transistor, hingga berbagai jenis rangkaian penguat dan filter, serta sistem elektronika digital. Mata kuliah ini mengajarkan kelistrikan secara dasar, disertai dengan pengembangan pengetahuan secra langsung lewat beberapa project kelistrikan dalam dunia sehari-hari yang umum dijumpai.
Bahan Kajian (Materi Pembelajaran)	1. Rangkaian Arus Searah (DC) 2. Rangkaian Arus Bolak-balik (AC) 3. Semikonduktor dan Dioda 4. Transistor Bipolar (BJT) 5. Transistor JFET

	6. Transistor MOSFET 7. Penguat Diferensial 8. Penguat Operasional (Op-Amp) 9. Rangkaian Filter 10. Elektronika Digital
Pustaka	1. Malvino, A. and D.J. Bates, Electronic Principles, 7th Edition. 2. Floyd, T.L., Buchla, D., 2002, Fundamentals of Analog Circuits, 2nd Edition 3. Warnes, L.A.A., 1994, Electronic and Electrical Engineering: Principles and Practice, Macmillan, London. 4. Sutrisno, 1986, Elektronika Teori Dasar dan Penerapannya 1,2 dan 3, Penerbit ITB, Bandung
Dosen Pengampu	Dr. Rahadi Wirawan, S.Si., M.Si. & Arif Budianto, M.Si.
Prasyarat	-

Ming. Ke	Kemampuan Akhir Tiap Tahapan Belajar (Sub CPMK)	Penilaian		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; Estimasi Waktu		Materi Pembelajaran	Bobot Penilaian (%)	Daftar Rujukan
		Indikator	Kriteria & Teknik					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Mahasiswa mampu mengaplikasikan konsep rangkaian setara dalam penyelesaian rangkaian arus searah/ DC (C3, A4)	1. Mampu menentukan resistansi sumber tegangan arus 2. Mampu membuat rangkaian setara Thevenin dan Norton 3. Mampu menentukan besarnya tegangan dan hambatan Thevenin dan arus Norton 4. Mampu menganalisis kerja rangkaian RC peristiwa pengisian dan pengosongan muatan kapasitor 5. Mampu menganalisis kerja rangkaian RC peristiwa integrator dan diferensiator	Sumber tegangan dan arus	• Bentuk: Kuliah • Aktivitas: SGD (*Small Group Discussion*) Estimasi Waktu • PT: 2 x (4x60") • KM: 2 x (4x60") • PB: 2 x (4x50")	Grup WA perkuliahan dan *link* daring unram	- Sumber tegangan dan arus - Rangkaian setara Thevenin dan Norton - Analisis rangkaian setara dalam rangkaian - Rangkaian RC pada peristiwa pengisian dan pengosongan muatan kapasitor - Rangkaian pengintegral dan pendeferensial RC	-	1,2,3,4

Ming. Ke	Kemampuan Akhir Tiap Tahapan Belajar (Sub CPMK)	Penilaian		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; Estimasi Waktu		Materi Pembelajaran	Bobot Penilaian (%)	Daftar Rujukan
		Indikator	Kriteria & Teknik					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2	Mahasiswa mampu menerapkan phasor dan konsep rangkaian RLC dan tapis pada penyelesaian permasalahan rangkaian arus bolak-balik/ AC (C3, A4)	1. Menjelaskan rangkaian tegangan dan arus berbentuk sinusoidal, serta impedansi pada arus bolak-balik 2. Menjelaskan diagram phasor pada rangkaian arus bolak balik 3. Menghitung nilai tegangan, arus dan impedansi dalam bentuk phasor 4. Menganalisis rangkaian serial RLC 5. Menganalisis rangkaian paralel RLC 6. Menganalisis rangkaian tapis lolos rendah dan tinggi	Analisis rangkaian RLC	• Bentuk: Kuliah • Aktivitas: SGD (*Small Group Discussion*) Estimasi Waktu • PT: 2 x (4x60") • KM: 2 x (4x60") • PB: 2 x (4x50")	Grup WA perkuliahan dan *link* daring unram	- Rangkaian tegangan dan arus bolak-balik - Phasor - Tegangan, arus dan impedansi dalam bentuk phasor - Rangkaian serial RLC - Rangkaian paralel RLC - Rangkaian tapis lolos rendah dan tinggi	-	1,2,3,4

Ming. Ke	Kemampuan Akhir Tiap Tahapan Belajar (Sub CPMK)	Penilaian		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; Estimasi Waktu		Materi Pembelajaran	Bobot Penilaian (%)	Daftar Rujukan
		Indikator	Kriteria & Teknik					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
3-4	Mahasiswa mampu menjelaskan dioda dan mendesain suatu rangkaian dioda dalam suatu rangkaian elektronika (C1, A1)	1. Mampu menjelaskan tentang teori atom dan pita energi dalam material atau bahan semikonduktor 2. Mampu menjelaskan teori semikonduktor intrinsik dan ekstrinsik 3. Mampu menjelaskan teori sambungan diode (junction diode) 4. Mampu menjelaskan susunan, sifat-sifat, dan rangkaian setara dalam komponen dioda 5. Mampu menganalisis rangkaian dioda,	Dioda dan semikonduktor	• Bentuk: Kuliah • Aktivitas: PBL (*Project Based Learning*) **Tugas 1 (Desain skematik rangkaian sederhana menggunakan komponen elektronika dioda dan semikonduktor lainnya)** Estimasi Waktu • PT: 2 x (4x60") • KM: 2 x (4x60") • PB: 2 x (4x50")	Grup WA perkuliahan dan *link* daring unram	- Semikonduktor - Dioda - Rangkaian Dioda - Dioda khusus	55%	1,2

Ming. Ke	Kemampuan Akhir Tiap Tahapan Belajar (Sub CPMK)	Penilaian		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; Estimasi Waktu		Materi Pembelajaran	Bobot Penilaian (%)	Daftar Rujukan
		Indikator	Kriteria & Teknik					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		penyearah gelombang 6. Mampu menganalisis regulator tegangan						
5	Mahasiswa mampu menelaah prinsip kerja dan karakteristik transistor bipolar (C1, A1)	1. Menjelaskan tentang teori atom dan pita energi dalam material atau bahan semikonduktor 2. Menjelaskan teori semikonduktor intrinsik dan ekstrinsik 3. Menjelaskan teori sambungan diode (*junction diode*) 4. Menjelaskan susunan, sifat-sifat, dan rangkaian setara dalam komponen dioda 5. Menganalisis rangkaian dioda,	Transistor bipolar	• Bentuk: Kuliah • Aktivitas: SGD (*Small Group Discussion*) dan Penugasan **Tugas 2 (Ringkasan materi pertemuan)** Estimasi Waktu • PT: 2 x (4x60") • KM: 2 x (4x60") • PB: 2 x (4x50")	Grup WA perkuliahan dan *link* daring unram	- Semikonduktor - Dioda - Rangkaian Dioda - Dioda khusus	5%	1,2,3,4

Ming. Ke	Kemampuan Akhir Tiap Tahapan Belajar (Sub CPMK)	Penilaian		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; Estimasi Waktu		Materi Pembelajaran	Bobot Penilaian (%)	Daftar Rujukan
		Indikator	Kriteria & Teknik					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		penyearah gelombang 6. Menganalisis regulator tegangan						
6-7	Mahasiswa mampu menelaah penguat transistor bipolar (C4, A4)	1. Mampu menjelaskan penguat transistor (CB, CE dan CC) 2. Mampu menjelaskan penguat transistor emitor ditanahkan (CE) 3. Mampu menjelaskan karakteristik, konsep garis beban, dan titik Q penguat CE 4. Mampu analisis penguat emitor CE dengan rangkaian setara parameter-h.	Penguat berbasis transistor bipolar	• Bentuk: Kuliah • Aktivitas: SGD (*Small Group Discussion*) Estimasi Waktu • PT: 2 x (4x60") • KM: 2 x (4x60") • PB: 2 x (4x50")	Grup WA perkuliahan dan *link* daring unram	- Penguat transistor emitor ditanahkan (CE) - Karakteristik, konsep garis beban, dan titik Q penguat CE - Analisis ac pada penguat emitor di tanahkan menggunakan rangkaian setara parameter-h - Prinsip kerja penguat kolektor	-	1,2,3,4

Ming. Ke	Kemampuan Akhir Tiap Tahapan Belajar (Sub CPMK)	Penilaian		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; Estimasi Waktu		Materi Pembelajaran	Bobot Penilaian (%)	Daftar Rujukan
		Indikator	Kriteria & Teknik					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		5. Mampu menjelaskan prinsip kerja CC 6. Mampu menerapkan penguat emitor sebagai regulator tegangan				ditanahkan/pengikut emitor		
8	**EVALUASI TENGAH SEMESTER (UTS)**						**10**	
9	Mahasiswa mampu menguraikan prinsip kerja JFET dan penerapannya (C4, A4)	1. Mampu menjelaskan teori dasar operasi JFET 2. Mampu menganalisis dc rangkaian JFET dan penerapannya 3. Mampu menganalisis ac rangkaian JFET dan penerapannya	Transistor JFET	• Bentuk: Kuliah • Aktivitas: FGD (*Forum Group Discussion*) dan penugasan **Tugas 3 (Rangkuman materi perkuliahan)** Estimasi Waktu • PT: 2 x (4x60") • KM: 2 x (4x60") • PB: 2 x (4x50")	Grup WA perkuliahan dan *link* daring unram	- Teori dasar JFET - Analisis rangkaian JFET dan aplikasinya	5	1,2,3,4

Ming. Ke	Kemampuan Akhir Tiap Tahapan Belajar (Sub CPMK)	Penilaian		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; Estimasi Waktu		Materi Pembelajaran	Bobot Penilaian (%)	Daftar Rujukan
		Indikator	Kriteria & Teknik					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
10	Mampu menganalisis prinsip kerja MOSFET dan penerapannya (C4, A4)	1. Mampu menjelaskan teori dasar operasi MOSFET 2. Mampu menganalisis dc rangkaian *MOSFET* dan penerapannya 3. Mampu menganalisis ac rangkaian *MOSFET* dan penerapannya	Transistor MOSFET	• Bentuk: Kuliah • Aktivitas: FGD (*Forum Group Discussion*) Estimasi Waktu • PT: 1 x (4x60") • KM: 1 x (4x60") • PB: 1 x (4x50")	Grup WA perkuliahan dan *link* daring unram	- MOSFET dan karakteristiknya - Analisis DC dan AC rangkaian penguat MOSFET	-	1,2,3,4
11	Mahasiswa mampu menganalisis suatu penguat diferensial dalam suatu rangkaian elektronika (C4, A4)	1. Menjelaskan karakteristik penguat differensial 2. Menghitung CMRR penguat diferensial 3. Menganalisis penguat diferensial dalam suatu rangkaian	Penguat differensial	• Bentuk: Kuliah • Aktivitas: FGD (*Forum Group Discussion*) Estimasi Waktu • PT: 1 x (4x60") • KM: 1 x (4x60") • PB: 1 x (4x50")	Grup WA perkuliahan dan *link* daring unram	- Dasar penguat diferensial - Common Mode Rejection Ratio - Sumber arus - Penguat diferensial gandengan emitor	-	1,2,3,4

Ming. Ke	Kemampuan Akhir Tiap Tahapan Belajar (Sub CPMK)	Penilaian		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; Estimasi Waktu		Materi Pembelajaran	Bobot Penilaian (%)	Daftar Rujukan
		Indikator	Kriteria & Teknik					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
12-13	Mahasiswa mampu menjelaskan karakteristik rangkaian penyusun penguat operasional (op-amp) (C4, A4)	1. Menjelaskan rangkaian penyusun opamp 2. Menentukan nilai parameter – parameter operasional amplifier	Penguat operasional	• Bentuk: Kuliah • Aktivitas: FGD (*Forum Group Discussion*) Estimasi Waktu • PT: 2 x (2x60") • KM: 2 x (2x60") • PB: 2 x (2x50")	Grup WA perkuliahan dan *link* daring unram	- Rangkaian penyusun Opamp - Karakteristik ideal - Perhitungan parameter - Common mode rejection ratio	-	1,2,3,4
14	Mahasiswa mampu menganalisis rangkaian filter aktif dan osilator dalam suatu rangkaian elektronika (C4, A4)	1. Menjelaskan konsep Active Filter (Butterworth Response) 2. Menjelaskan osilator RC, LC dan Kristal 3. Menganalisis prinsip kerja osilator dalam suatu rangkaian elektronika	Filter aktif dan osilator	• Bentuk: Kuliah • Aktivitas: SGD (*Small Group Discussion*) Estimasi Waktu • PT: 2 x (2x60") • KM: 2 x (2x60") • PB: 2 x (2x50")	Grup WA perkuliahan dan *link* daring unram	- Filter aktif - Osilator	-	1,2,3,4
15	Mahasiswa mampu menguraiakn konsep	1. Melakukan operasi aritmatika biner	Dasar-dasar elektronika digital	• Bentuk: Kuliah • Aktivitas: SGD (*Small Group*	Grup WA perkuliahan dan *link*	- Sistem biner dan aritmatika biner	5	1,2,3,4

Ming. Ke	Kemampuan Akhir Tiap Tahapan Belajar (Sub CPMK)	Penilaian		Bentuk Pembelajaran; Metode Pembelajaran; Penugasan Mahasiswa; Estimasi Waktu		Materi Pembelajaran	Bobot Penilaian (%)	Daftar Rujukan
		Indikator	Kriteria & Teknik					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	dasar elektronika digital (C4, A4)	2. Menganalisa luaran dari rangkaian gerbang logika 3. Menjelaskan konsep ADC dan DAC		*Discussion*) dan **Quiz** Estimasi Waktu • PT: 2 x (2x60") • KM: 2 x (2x60") • PB: 2 x (2x50")	daring unram	- Gerbang logika - ADC dan DAC		
16	**EVALUASI AKHIR SEMESTER (UAS)**						**20**	

Catatan:

1. Bobot nilai adalah persentase di luar UTS dan UAS; 2. Total penilaian mengikuti panduan akademik yang berlaku

Template 2. Rencana Tugas Mahasiswa (RTM)

	UNIVERSITAS MATARAM **FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM** **PROGRAM STUDI FISIKA**
RENCANA TUGAS MAHASISWA (RTM)	
Mata Kuliah	
Kode	
Dosen Pengampu	
Bentuk Tugas	
Sub CPMK	
Diskripsi Tugas	
Metode PengerjaanTugas	
Bentuk dan Format Luaran	
Indikator, Kreteria, danBobot Penilaian	
Jadwal Pelaksanaan	
Lain-lain	
Daftar Rujukan	

Contoh: Rencana Tugas Mahasiswa (RTM) ke-1 (*Project Based Learning*)

	UNIVERSITAS MATARAM **FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM** **PROGRAM STUDI FISIKA**
RENCANA TUGAS MAHASISWA (RTM)	
Mata Kuliah	Elektronika Dasar
Kode	FIS21309
Dosen Pengampu	Dr. Rahadi Wirawan, S.Si., M.Si.; Arif Budianto, M.Si.
Bentuk Tugas	***Project Based Learning*** **Waktu Pengerjaan Tugas: 2 minggu**
Judul Tugas	**Tugas-1 Desain skematik rangkaian sederhana menggunakan komponen elektronika dioda dan semikonduktor lainnya**
Sub CPMK	3
Deskripsi Tugas	Merancang skematik rangkaian listrik sederhana dengan kombinasi berbagai komponen elektronika dengan point utama pada komponen dioda dan semikonduktor lainnya menjadi rangkaian, seperti: (1) Seri dengan kombinasi dioda (2) Paralel dengan kombinasi dioda (3) Teorema superposisi dilengkapi dioda dan LED (4) Penyearah arus dengan menggunakan dioda
Metode Pengerjaan Tugas	-Membuat gambar jalur secara manual di atas kertas -Mengimplementasi skematik tersebut dalam skematik instrumentasi -Merancang skematik menjadi sebuah rangkaian
Bentuk Dan Format Luaran	a. **Obyek Garapan:** Gambar skematik dan desain alat jadi (purwarupa) b. **Bentuk Luaran:** (1) Seri dengan kombinasi dioda; (2) Paralel dengan kombinasi dioda; (3) Teorema superposisi dilengkapi dioda dan LED; (4) Penyearah arus dengan menggunakan dioda
Indikator Kinerja Dan Bobot Penilaian	a. Laporan hasil project (100%) - Sinyal keluaran dari rangkaian tegangan terukur dengan multimeter digital, kemudian divalidasi dengan osiloskop digital untuk mengamati bentuk sinyal keluaran. Skala penilaian mengacu pada standar penilaian dengan skor 0-100.
Jadwal Pelaksanaan	Mulai minggu ke-3 sampai dengan minggu ke-4
Lain-Lain	-
Daftar Rujukan	1. Malvino, A. and D.J. Bates, Electronic Principles, 7th Edition. 2. Floyd, T.L., Buchla, D., 2002, Fundamentals of Analog Circuits, 2nd Edition 3. Warnes, L.A.A., 1994, Electronic and Electrical Engineering: Principles and Practice, Macmillan, London. 4. Sutrisno, 1986, Elektronika Teori Dasar dan Penerapannya 1,2 dan 3, Penerbit ITB, Bandung.

Template 3. Portofolio Mata Kuliah

	UNIVERSITAS MATARAM **FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM** **PROGRAM STUDI FISIKA**

DAFTAR KELENGKAPAN PORTOFOLIO MATA KULIAH

Tahun Akademik :	Semester :
Nama MK :	Kode :
Kelas : A/B*)	Rumpun MK :
Dosen Pengampu : 1) 2)	

No	Daftar KelengkapanPortofolio MK	Status Kelengkapan**)	
		Ada	Tidak Ada
1.	Rencana Pembelajaran Semester (RPS) Mata Kuliah		
2.	Absensi Kehadiran Dosen		
3.	Absensi Kehadiran Mahasiswa		
4.	Soal Evaluasi (Ujian Tengah dan Akhir Semester)		
5.	OBE : Laporan Pencapaian Keseluruhan Capaian Pembelajaran Mata Kuliah (CPMK)		

Catatan:

**) Coret yang tidak perlu*

***)Beri tanda pada Status Kelengkapan dengan√ pada kolom terkait ketersediaan dokumen*

Mataram, hari – bulan – tahun

DosenPengampu 1,	DosenPengampu 2,
(NamaDosen) **NIP.**	**(NamaDosen)** **NIP.**

UNIVERSITAS MATARAM
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
PROGRAM STUDI FISIKA

PORTOFOLIO MATA KULIAH

Tahun Akademik :	Semester :
Nama MK :	Kode :
Dosen Pengampu :	Rumpun MK :

1.	**Pendahuluan** (ceritakan penjelasan yang diperlukan tentang matakuliah ini)
2.	**Tujuan** (jelaskan tujuan perkuliahan umum maupun khusus)
3.	**Metode Pembelajaran** (jelaskan strategi yang digunakan untuk mencapai tujuan perkuliahan - CPMK)
4.	**Isi Perkuliahan** (jelaskan kesuaiannya dengan kurikulum yang berlaku)
5.	**Peserta Kuliah** (berikan gambaran tentang peserta kuliah)
6.	**Persentase Kehadiran** (% kehadiran dosen ; % kehadiran mahasiswa)
7.	**Sistem Evaluasi** (jelaskan tentang tugas terstruktur, kuis, ujian, praktikum , dll)
8.	**Hasil Capaian Pembelajaran** (jelaskan tentang capaian atas tujuan yang telah ditetapkan, masukkan pula ketercapaian pembelajaran yang dapat dijelaskan)
9.	**Distribusi Nilai** (berikan distribusi nilai berikut ketercapaian capaian pembelajaran mata kuliah ini) • **Indikator ketercapaian (*achieved*) adalah apabila 50% jumlah mahasiswa peserta kuliah mendapatkan nilai akhir ≥ 65**
10.	**Kesimpulan**
11.	**Rekomendasi Perbaikan**
	Lampiran:

1. RPS Mata Kuliah	2. Absensi Kehadiran Mahasiswa
3. Absensi Kehadiran Dosen	4. Soal Ujian Akhir Semester
5. OBE: Laporan Pencapaian Keseluruhan CPMK	