USK
UNIVERSITAS
SYIAH KUALA

Kampus Merdeka
INDONESIA JAYA

CURRICULUM BOOK

2024-2028

Based on The Rector's Decree
No. : 7777/UN11/KPT/2024

Bachelor in Physics Study Program

FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS SYIAH KUALA

CURRICULUM DOCUMENT
STUDY PROGRAM
BACHELOR IN PHYSICS

UNIVERSITAS SYIAH KUALA
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
DARUSSALAM, 2024

IDENTITY OF THE STUDY PROGRAM

Specification of Study Program

1	Name of Institution	*Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Syiah Kuala*
2	Name of the Study Program	*Bachelor in Physics*
3	Level of Education	*Bachelor's Degree (S1)*
4	Address of the Study Program	*Kampus Kopelma Darussalam, Banda Aceh*
5	Accreditation Status and its Accreditation Board, for example: BAN-PT, LAM/International Accreditation Organization	*A (BAN-PT)*
6	Degree/Graduate Designation	*Sarjana Sains/S.Si.*
7	Length of Study and number of credits earned in ECTS	*8 Semester (230.4 ECTS)*

BACHELOR IN PHYSICS STUDY PROGRAM PROFILE

The Bachelor in Physics Study Program (SPHY) is part of the Department of Physics, Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Syiah Kuala. This study program was established in 1989 based on the National Accreditation Board for Higher Education of the Ministry of Education and Culture of the Republic of Indonesia No. 10/Dikti/Kep/1989 dated February 17, 1989. Initially, SPHY was directly under the Coordinator of Mathematics and Natural Sciences. Following the establishment of the Faculty of Mathematics and Natural Sciences (MIPA) in 1993, it was placed under the management of the Faculty of Mathematics and Natural Sciences (FMIPA).

In its first formative years, SPHY's goal was to fulfill the need for basic science graduates, particularly in the field of physics, to support national development. Over time, SPHY continues to develop in order to enhance the quality of education in the study program. Currently, after 32 years of foundation, SPHY has established building infrastructure, modern laboratories to support the education, training and research process. SPHY currently has 34 lecturers, of whom 23 have Doctoral degrees, and 6 of the lecturers who have Doctoral degrees have the functional position of Professor. SPHY currently holds an A accreditation rating based on the National Accreditation Board for Higher Education (BANPT) No. 3171/SK/BAN-PT/Ak-PPJ/S/V/2021.

DECREE OF THE COMPOSING TEAM

KEMENTERIAN PENDIDIKAN, KEBUDAYAAN,
RISET, DAN TEKNOLOGI
UNIVERSITAS SYIAH KUALA
Darussalam, Banda Aceh 23111
Telepon (0651) 7553205, 7553248, 7554394, 7554395, 7554396, 7554398
Faksimile (0651) 7554229, 7551241, 7552730, 7553408
Laman www.usk.ac.id, Surel info@usk.ac.id

KEPUTUSAN REKTOR UNIVERSITAS SYIAH KUALA
NOMOR No SK: 71/UN11.1.8/KPT/2024
TENTANG
PENUNJUKAN TIM PENYUSUN KURIKULUM OUTCOME BASED EDUCATION (OBE) PADA PROGRAM STUDI SARJANA FISIKA DEPARTEMEN FISIKA FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM UNIVERSITAS SYIAH KUALA

REKTOR UNIVERSITAS SYIAH KUALA,

Menimbang :

a. bahwa untuk kelancaran pelaksanaan kegiatan Penyusunan Kurikulum Outcome Based Education (OBE) Pada Program Studi Sarjana Fisika Departemen Fisika Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Syiah Kuala, maka perlu ditunjuk Tim Penyusun yang bertugas untuk itu;
b. bahwa untuk keperluan dimaksud, perlu ditetapkan dengan Keputusan Rektor;

Mengingat :

1. Undang-Undang Nomor 17 Tahun 2003 tentang Keuangan Negara;
2. Undang-Undang Nomor 1 Tahun 2004 tentang Perbendaharaan Negara;
3. Undang-Undang Nomor 12 Tahun 2012 tentang Pendidikan Tinggi;
4. Undang-Undang Nomor 19 Tahun 2023 tentang Anggaran Pendapatan dan Belanja Negara Tahun Anggaran 2024;
5. Peraturan Pemerintah Nomor 4 Tahun 2014 tentang Penyelenggaraan Pendidikan Tinggi dan Pengelolaan Perguruan Tinggi;
6. Peraturan Pemerintah Nomor 38 Tahun 2022 tentang Perguruan Tinggi Negeri Badan Hukum Universitas Syiah Kuala;
7. Peraturan Menteri Keuangan Nomor 49 Tahun 2023 tentang Standar Biaya Masukan Tahun Anggaran 2024;
8. Peraturan Rektor Nomor 5 Tahun 2024 tentang Organisasi dan Tata Kerja Unsur Rektor Universitas Syiah Kuala;
9. Keputusan Rektor Universitas Syiah Kuala Nomor 6002/UN11/KPT/2023 tentang Pemberhentian/Pengangkatan Dekan Fakultas MIPA Universitas Syiah Kuala periode 2023-2026;
10. Keputusan Rektor Universitas Syiah Kuala Nomor 1470/UN11/KPT/2024 tentang Pelimpahan Kewenangan Penandatanganan Keputusan Rektor Kepada Wakil Rektor, Ketua Lembaga, Dekan, dan Direktur Sekolah Pascasarjana Universitas Syiah Kuala;

MEMUTUSKAN:

Menetapkan : KEPUTUSAN REKTOR TENTANG PENUNJUKAN TIM PENYUSUN KURIKULUM OUTCOME BASED EDUCATION (OBE) PADA PROGRAM STUDI SARJANA FISIKA DEPARTEMEN FISIKA FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM UNIVERSITAS SYIAH KUALA.

KESATU : Menunjuk Saudara-saudara yang namanya tercantum pada daftar lampiran keputusan ini sebagai Tim Penyusun kegiatan Penyusunan Kurikulum Outcome Based Education (OBE) pada Program Studi Sarjana Fisika Departemen Fisika Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Syiah Kuala.

KEDUA : Kegiatan ini dilaksanakan pada bulan Januari 2024 sampai dengan bulan Juni 2024.

KETIGA : Segala biaya yang diakibatkan oleh keluarnya keputusan ini dibebankan pada Anggaran PTNBH Universitas Syiah Kuala Tahun Anggaran 2024 SUKPA Fakultas Matematika dan Ilmu Pengetahuan Alam yang sesuai dengan Peraturan Keuangan.

KEEMPAT : Keputusan ini mulai berlaku pada tanggal 2 Januari 2024 dan apabila dalam penetapan ini kemudian ternyata terdapat kekeliruan akan diperbaiki kembali sebagaimana mestinya.

Ditetapkan di Banda Aceh
pada tanggal 16 April 2024

a.n. REKTOR UNIVERSITAS SYIAH KUALA,
DEKAN FAKULTAS MATEMATIKA DAN ILMU
PENGETAHUAN ALAM

Prof. Dr. Taufik Fuadi Abidin, S.Si., M.Tech
NIP 197010081994031002

LAMPIRAN
KEPUTUSAN REKTOR UNIVERSITAS SYIAH KUALA
NOMOR No SK: 71/UN11.1.8/KPT/2024, TANGGAL 16 APRIL 2024
TENTANG
PENUNJUKAN TIM PENYUSUN KURIKULUM OUTCOME BASED EDUCATION (OBE) PADA PROGRAM STUDI SARJANA FISIKA DEPARTEMEN FISIKA FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM UNIVERSITAS SYIAH KUALA

No	Nama/NIP/NIPK	Pangkat/Gol	Jabatan dalam Dinas	Jabatan dalam Panitia	Rincian Tugas	Tugas dan Fungsi
1	Dr. Saumi Syahreza, S.Si., M.Si 197609172005011002	Penata Tk. I (Gol. III/d)	Ketua Departemen Fisika	Pengarah	Mengarahkan seluruh anggota tim dalam penyusunan kurikulum Departemen Fisika	Ya
2	Dr. Malahayati, S.Si., M.Si 197407252000122001	Penata Tk. I (Gol. III/d)	Sekretaris Departemen Fisika	Penanggung Jawab	Bertanggung jawab terhadap pelaksanaan kegiatan penyusunan kurikulum Prodi Fisika secara keseluruhan	Ya
3	Dr. Faisal, S.Si, M.Sc 197012201998021001	Pembina (Gol. IV/a)	Koordinator Program Studi S-2 Pengelolaan Sumberdaya Pesisir Terpadu	Ketua	Bertanggung jawab terhadap pelaksanaan kegiatan penyusunan kurikulum Prodi S1 Fisika secara keseluruhan	Tidak
4	Bukhari, S.Si., M.T 197007051998031004	Penata (Gol. III/c)	Lektor	Sekretaris	Membantu menyusun Profile, CPL, Kompetensi lulusan	Tidak
5	Prof. Dr. Syahrun Nur, S.Si., M.Si 196712241994031001	Pembina Utama (Gol. IV/e)	Guru Besar	Anggota	Mengkoordinir penyusunan mata kuliah bidang minat Optika dan Aplikasi Laser	Tidak
6	Irhamni, S.Si., M.Si 197101061997022001	Penata (Gol. III/c)	Lektor	Anggota	Mengkoordinir penyusunan bahan kajian mata kuliah, kode mata kuliah dan bobot SKS mata kuliah	Tidak
7	Dr. Rini Safitri, S.Si., M.Si. 197004251995122001	Pembina (Gol. IV/a)	Lektor Kepala	Anggota	Mengkoordinir penyusunan mata kuliah bidang minat Fisika Medis	Tidak
8	Fauzi, S.Si, M.Si 196609281994031014	Penata Tk. I (Gol. III/d)	Lektor	Anggota	Mengkoordinir penyusunan mata kuliah bidang minat Fisika Material	Tidak
9	Dr. Rajibussalim, M.Sc, M.InfoTech 197208311998021001	Penata Tk. I (Gol. III/d)	Lektor	Anggota	Mengkoordinir penyusunan mata kuliah bidang minat Fisika Teori dan Komputasi	Tidak
10	Dr. Ir. Didik Sugiyanto, M.T. 197312072003121002	Penata (Gol. III/c)	Lektor	Anggota	Mengkoordinir penyusunan mata kuliah bidang minat Fisika Bumi (Geofisika)	Tidak
11	Dr. M. Syukri Surbakti, S.Si., M.Si 197310302000121001	Penata (Gol. III/c)	Lektor	Anggota	Mengkoordinir penyusunan mata kuliah bidang minat Elektronika Instrumentasi	Tidak
12	Zulfalina, S.Si., M.Si 197507072002122001	Penata (Gol. III/c)	Lektor	Anggota	Mengkoordinir daftar ekivalensi mata kuliah, prasyarat, dan struktur kurikulum	Tidak

No	Nama/NIP/NIPK	Pangkat/Gol	Jabatan dalam Dinas	Jabatan dalam Panitia	Rincian Tugas	Tugas dan Fungsi
13	Cut Nunun Badriannisa, S.Si. 1171045608940002	-	Pengadministrasi Akademik	Anggota	Membantu administrasi dan dokumentasi kegiatan penyusunan kurikulum prodi S1 Fisika	Tidak

Ditetapkan di Banda Aceh
pada tanggal 16 April 2024

a.n. REKTOR UNIVERSITAS SYIAH KUALA,
DEKAN FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM

Prof. Dr. Taufik Fuadi Abidin, S.Si., M.Tech
NIP 197010081994031002

PREFACE

Curriculum development is a very important step in ensuring the academic quality of a study program. It aims to prepare students with competencies that align with the development of Science and Technology (IPTEK) and to respond to increasingly complex and competitive challenges in the era of globalization. In this context, it is important to adjust the study program curriculum by taking into account the technological developments of the Industrial Revolution 4.0, the Independent Learning Independent Campus (**MBKM**) policy, Permendikbudristek Number 53 of 2023 concerning Quality Assurance of Higher Education, and the status of Universitas Syiah Kuala as a Legal Entity State University.

Curriculum changes in all study programs in the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Syiah Kuala (USK) follow the Outcome-Based Education (OBE) approach. This approach ensures that the curriculum is designed to achieve concrete and measurable learning objectives. The teaching methods in the OBE curriculum ensure that every aspect of learning has clear, measurable and job-relevant objectives. As such, every element in the curriculum, assessment, and teaching process are all oriented towards achieving the learning outcomes that have been set.

The preparation of the current OBE curriculum is carried out by considering various aspects, including Permendikbudristek Number 53 of 2023 concerning Quality Assurance of Higher Education, the Indonesian National Qualifications Framework, MBKM policy, developments in science and technology, as well as input from various parties, such as scientific associations, government, industry, and alumni. However, it is realized that there are still shortcomings in the process of preparing this curriculum. Therefore, we would appreciate constructive feedback and suggestions to improve this curriculum in the time to come.

We would like to thank the department leaders, study program coordinators, curriculum development team, and all those who have contributed and supported the curriculum change process. Hopefully, the curriculum that has been developed can provide meaningful benefits for students and graduates of FMIPA USK.

Darussalam, 6 Mei 2024
Dekan,

Prof. Dr. Taufik Fuadi Abidin, S.Si., M.Tech.

TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

The curriculum is designed to enhance the quality of learning and produce graduates who are well-prepared to enter the workforce, meeting the demands of society. Therefore, curriculum changes in Higher Education are routine activities that must be carried out in response to the development of Science and Technology (IPTEK) (scientific vision), societal needs, and the needs of graduate users (stakeholder needs).

After conducting an in-depth evaluation and analysis of various aspects such as the implementation of the teaching and learning process based on the 2021 curriculum. In addition, the development of physics with its various branches, the development of expertise in the field of physics pursued and mastered by lecturers in the Bachelor in Physics Study Program (SPHY), the suitability and compatibility of courses at the undergraduate and postgraduate levels, the development of the world of work that will absorb graduates, and the development of modern life demands as a consideration. The drive to improve the link and match with industry, the world of work and the rapidly changing future motivated the development of a new curriculum for SPHY, which is an improvement on the previous curriculum.

In the preparation of this new 2024 curriculum, we have involved external parties such as the Physical Society of Indonesia (PSI), alumni, and stakeholders (Aceh Provincial Education Board, Aceh Disaster Management Agency, BAPEDA Aceh, Zainal Abidin Hospital, BMKG, Citibank Indonesia, BRIN, Balai Guru Penggerak, PLN-Aceh, BAPETEN, PT Solusi Bangun Andalas, PPM Mandiri Pharmacy Academy, Secondary School Teachers, private universities in Aceh and the Cultural Preservation Center).

1.1 Curriculum Document Preparation Process

The process of developing the 2024 curriculum began with a curriculum evaluation workshop and identification of the desired competencies of the graduates to be achieved. This activity was attended by all lecturers of the Department of Physics. To complement the curriculum evaluation process, data from the Tracer Study survey of alumni who graduated in 2021 and 2022 were also taken into consideration in determining the profile of graduates. Then followed by FGDs on the preparation of the vision, mission and objectives of the Bachelor in Physics Study Program. This FGD was attended by the aforementioned stakeholders to gather input on the profile of graduates and the skills required by current graduates in the workforce. In-depth discussions were held to ensure that each competency selected was relevant and measurable. Based on this, a graduate profile is determined which consists of Educators, Research Assistants, Socio Science-technopreneurs and Industrial Practitioners.

After formulating the learning objectives, the next step is to determine the specific learning outcomes for each course. All lecturers from the study program are involved in identifying the skills, knowledge and attitudes that students are expected to achieve. This process involves an in-depth analysis of stakeholder engagement in learning activities to appropriate and relevant evaluation.

Once all the components of the curriculum are clearly defined, the process of drafting the curriculum document can begin. The curriculum team, consisting of lecturers and academic staff, work together to integrate all learning elements into a comprehensive document. This document includes a brief description of the learning objectives, expected learning outcomes, proposed learning strategies, evaluation methods, and other supporting resources. The final stage in this process is the validation and evaluation of the developed curriculum. The curriculum team organizes a meeting session or workshop to discuss the document with lecturers and stakeholders. The feedback received is used to undertake final revisions before the final document is approved and implemented.

The overall process of developing the OBE curriculum document involved close collaboration between practitioners, stakeholders and SPHY faculty and students. This is a concerted effort to ensure that the study program provides relevant, outcome-oriented learning experiences and prepares graduates well for the challenges ahead.

1.2 Curriculum Evaluation and Tracer Study

A. Curriculum Implementation Evaluation Results

What needs to be considered in the development, implementation and evaluation of curriculum based on SN-Dikti is that the SKL/ILO section is the main reference or foundation. Thus, the Higher Education Curriculum that has been developed based on SN-Dikti has used the Outcome-Based Education (OBE) approach, which focuses on achieving ILOs. In addition, the formulation of ILOs is also based on the results of evaluating the study program curriculum, which involves measuring the achievement of the ILOs in the current curriculum. This evaluation incorporates input from graduate users, alumni, and experts in their respective fields. Curriculum evaluation also examines the development of science and technology in relevant fields at the time the curriculum was developed, the needs of the labor market, and the vision and values developed by each institution.

Since its establishment in 1989 until now, the Bachelor of Physics (SPHY) Study Program of the Department of Physics FMIPA Universitas Syiah Kuala (USK) has changed the curriculum seven times. In 2011, SPHY implemented a competency-based curriculum in accordance with applicable laws and regulations. The establishment of the Indonesian National Qualifications Framework (KKNI) by

the government through Presidential Regulation No. 8/2012, Law No. 12/2012 on Higher Education and Permendikbud No. 73/2013 on the application of KKNI to the higher education curriculum. Therefore, the USK Rector requires all study programs under USK to develop a curriculum that meets the KKNI provisions. Therefore, since 2014, SPHY has revised the curriculum and has produced a curriculum based on KKNI, namely the 2016 Curriculum. To answer the development and needs of the industrial revolution 4.0 era, in 2020 the government through the Ministry of Higher Education and Research and Technology launched an Independent Learning Independent Campus (MBKM) based higher education curriculum, where students are allowed to do activities outside the study program or off campus for three semesters with a minimum credit load of 20 credits. SPHY revised its MBKM-based curriculum by developing the 2021 Curriculum, which has been in effect since 2021.

In 2024, the USK Rector again required all study programs under USK to revise the curriculum based on the OBE approach. Outcome-Based Education (OBE) is a curriculum that refers to outcomes. So it is not only the material that must be applied in the classroom, but also preparing graduates (outcomes) who have been equipped with the ability to face the world of work. When a campus implements the OBE curriculum, it means that the campus also supports the Independent Learning Independent Campus (MBKM) policy. So through the implementation of this program, universities will be better prepared to project their graduates to compete in the global world. In addition, students can focus on completing compulsory courses until semester 6, after which they can join the MBKM program without any obstacles in converting the grades of the courses they have followed. Based on the facts mentioned above, SPHY FMIPA USK revised the 2021 Curriculum based on KKNI to become Curriculum 2024, which uses ILO concepts and achievements with an OBE approach. The total number of credits is maintained at 144, and the fields of study that are maintained are the fields of basic science, information and computing technology, and entrepreneurship because they have become the concept of the vision and mission of USK. The curriculum script is refined at the Study Program level and is consulted with stakeholders and assistance from LPPM USK, as a university quality assurance institution. Observing the curriculum that must be adaptive, innovative, and efficient, the courses compiled in the 2024 Curriculum also seek to improve the OBE Course Syllabus (RPS) learning tools.

Tracer Study is a tracking study of SPHY graduates/alumni two years after graduation. It aims to determine the outcome of education in the form of transition from the world of higher education to the world of work, educational outputs, namely self-assessment of mastery and acquisition of competencies,

educational processes in the form of evaluation of learning processes and the contribution of higher education to competency acquisition and educational inputs in the form of further exploration of sociobiographical information on graduates.

The Tracer Study was conducted by UPT Career Development Center (CDC) USK by means of a census. The data collection method is done through a survey on the CDC website. Baseline data on graduates is collected from the exit survey database, a survey conducted before graduates complete their studies, and cross-matched with the academic database. Messaging about the implementation of the tracer study is done using various media. Completion is monitored by CDC enumerators. The collected data were then tabulated and analyzed.

The tracer study document is very useful for users and managers of SPHY FMIPA USK, Banda Aceh. For users, the results of this study are expected to be helpful to be one of the considerations for stakeholders to be able to utilize alumni from SPHY FMIPA USK as one of the staff in their company. For the organizers, it is expected to be useful for determining the strategy and orientation of education, making improvements to the concept and technical implementation of education and teaching so that graduates are getting better in their intellectual capacity, skills and morals and personality.

The results of this tracer study are expected to be used as a consideration in developing the quality of the learning process and learning evaluation as well as developing educational management. With continuous improvement of these aspects, it is expected that education at SPHY FMIPA USK, Banda Aceh can run efficiently, effectively, and productively and in time increase the competitiveness of alumni.

Profile of Tracer Study Respondents

The total number of respondents of SPHY FMIPA graduates in 2021 and 2022 who filled out the survey completely was 42%. Details The number of SPHY graduates in 2021 and 2022 are 22 and 45 people respectively. The number of respondents who completed the survey were 8 and 20, respectively. Despite the moderate response rate from alumni, the high response rate indicates that the data is representative of the graduate population. However, perceptual surveys in tracer studies often produce biased data because perceptions of questions differ among graduates. The composition of respondents based on undergraduate study programs is listed in Table 1.1.

Table 1.1. Respondent population per SPHY FMIPA in 2021 and 2022

Undergraduate Program	Number of graduates in 2021	Number of graduates in 2022	Total	% of Respondents
Targeted population	22	45	67	
Respondent	8	20	28	42%
Completion rate	3	8	12	18%

The composition of respondents was based on gender, which was dominated by women. The ratio between male and female respondents is 75:25 (Figure 1.1a). This difference in proportion also occurs because the number of female students in recent years is greater than that of male students. Although not normally distributed, gender representation can be used for analysis.

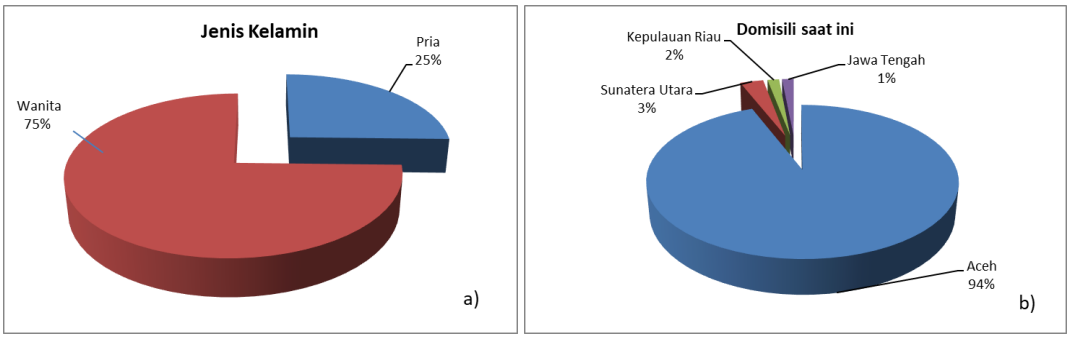


Figure 1.1. Distribution of respondents based on (a) Gender type (b) Domicile at the time of survey

Most of the respondents resided in Aceh. Only a small proportion reside outside Aceh Province (Figure 1.1b). Based on this data, it is unclear why many respondents did not seek employment outside Aceh Province. Out of a total of 28 respondents, around 42% were employed, 16% were continuing their studies, 6% were entrepreneurs, and 34% were looking for work. The data also shows the low interest of graduates in entrepreneurship. An alarming fact is that 34% of graduates are still looking for work after one year and two years of graduation (Figure 1.2).

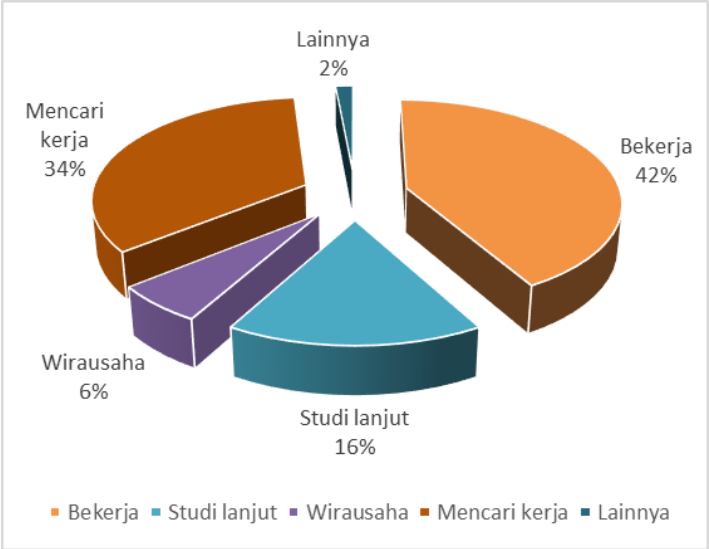


Figure 1.2. Respondents' activities during the survey (n=28)

Employment status and form of employment

A total of 56% of respondents work full-time. The proportion of those working part-time and freelance are 19% and 12%, respectively (Figure 1.3a). Those who work part-time (less than 35 hours per week) can be categorized as underemployed. In terms of economic productivity, this is not recommended because undergraduate education requires a large investment. Further analysis is needed to determine whether this underemployment status is a choice (especially among women) or due to limited formal employment opportunities.

Although the proportion of respondents working full-time is very high, only about 37% are permanent employees. Nearly half of the respondents who were employed were contract workers (44%), 9% worked for third parties, and 13% worked for other employers (Figure 1.3b). The high number of people working as contract employees and others will be related to the amount of salary received. Contract employees tend to receive lower incomes than permanent employees. In addition, the turnover rate (job turnover) is expected to be high because contracts are usually short-term. The reasons why respondents work without a contract should be investigated further. The results of the study may serve as input so that information on workers' rights can be conveyed earlier, when they are still students.

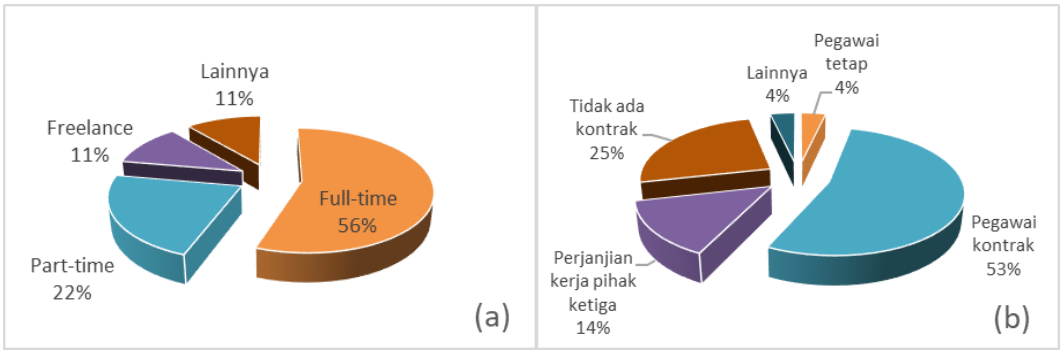


Figure 1.3 (a) Employment status, and (b) Type of employment contract (n=27)

Approximately 50% of respondents work for government agencies. The number of respondents working in private companies was 25%, non-profit organizations/NGOs 13%, self-employed/entrepreneurs 6% and others 6% (Figure 1.4a). **The business fields of the companies/agencies entered by respondents varied greatly, but education was the largest (50%).** The rest are spread across ICT, NGOs, health and social services, other business sectors, and others, with proportions of 6%, 6%, 6%, 7%, and 25%, respectively. The remaining respondents work in other business fields, each with a very small proportion. Nearly a quarter of respondents did not specify the field of work they were engaged in (Figure 1.4b). The field of education is most likely a school or tutoring institution. Almost half of respondents work for companies/institutions with more than 100 employees. The rest are companies with fewer than 50 employees, of which 19% have fewer than 10 employees (Figure 1.4c).

B. Fundamentals of Change

The 2024 curriculum changes are based on the results of a tracer study conducted by the Career Development Center (CDC) of Universitas Syiah Kuala, utilizing the network and information system developed by USK. The survey data used is data on graduates from 2021 to 2023 who graduated under the previous curriculum. Other considerations used in this curriculum change were the results of focus group discussions with stakeholders, rapid developments in information technology, analysis of the latest SDGs mission, and analysis of the vision and mission of USK and the Faculty of Mathematics and Natural Sciences.

C. Formulation of Changes

The main aspect that has changed in this curriculum is the use of the Outcome Based Education (OBE) approach, which focuses on achieving ILO. The formulation of ILOs is based on the results of the evaluation of the current study program curriculum through the measurement of ILO achievement. Another aspect that has also undergone significant improvement is the RPS and lecture

contracts, which must include a detailed learning evaluation process that enables the evaluation of ILO achievement, which is a key feature of curricula that use the OBE approach.

1.3 Basis for Curriculum Design and Development

A. Philosophical Basis

Education is provided following the applicable education curriculum. The basic written rules regarding the right to education are contained in Article 31 of the 1945 Constitution, which states that every Indonesian citizen has the right to a proper education. The level of educational feasibility is assessed based on the quality of education as reflected in the competencies of graduates. The competency standards for graduates in this case are measured based on Learning Outcomes (ILO). In practice, the learning process aims to develop students' potential through a series of learning activities based on the values of Pancasila, the philosophy and ideology of the Indonesian nation, which serves as the foundation for all aspects of life in Indonesia.

B. Sociological Basis

It forms the basis for curriculum development as a physics education tool consisting of objectives, materials, learning activities, and a positive learning environment for learners to gain experiences relevant to their personal and social development (Ornstein & Hunkins, 2014). The SPHY curriculum must be able to pass on culture from one generation to the next amid the onslaught of globalization, which continues to erode the existence of local culture. Physics students need to recognize aspects of local culture in order to protect themselves from the influence of globalization. Palfreyman (2007) states that cultural issues have become a hot topic among academics in various countries where universities are expected to be able to balance the interests of advancing learning processes oriented towards scientific and technological progress with the cultural diversity of students, which can result in learning outcomes with the ability to understand cultural diversity in society, thereby fostering a spirit of tolerance and mutual understanding toward the presence of diversity. Physics students are expected to have cultural agility as a mega competency that must be possessed by prospective professional graduates in the 21st century, with a minimum mastery of three competencies, namely cultural minimization, which is the ability to control oneself and adapt to standards, cultural adaptation in working conditions at the international level, and cultural integration (Caligiuri, 2012).

C. Psychological Basis

It serves as the foundation for curriculum development, enabling the curriculum to continuously foster students' curiosity in physics and motivate lifelong learning; a curriculum that facilitates physics students' learning so they can recognize their role and function within their environment; a curriculum that can encourage students to think critically, engage in higher-order thinking, and perform advanced reasoning; a curriculum that can optimize the development of students' potential into the kind of individuals desired (Zais, 1976, p. 200); a curriculum that can facilitate students' learning to become well-rounded individuals, namely individuals who are free, responsible, confident, moral or virtuous, capable of collaboration, tolerant, and educated individuals with the determination to contribute to the achievement of the ideals outlined in the preamble of the 1945 Constitution.

D. Juridical Basis

The legal basis serves as the foundation or reference for the stages of design, development, implementation, and evaluation, as well as the quality assurance system of higher education institutions that will ensure the implementation of the curriculum and the achievement of its objectives. Some of the legal bases for the development and implementation of the Physics Study Program curriculum are:

1. Law of the Republic of Indonesia Number 14 of 2005 concerning Teachers and Lecturers (State Gazette of the Republic of Indonesia of 2005 Number 157, Supplement to the State Gazette of the Republic of Indonesia Number 4586);
2. Law of the Republic of Indonesia Number 12 of 2012 concerning Higher Education (State Gazette of the Republic of Indonesia Year 2012 Number 158, Supplement to the State Gazette of the Republic of Indonesia Number 5336);
3. Regulation of the President of the Republic of Indonesia Number 8 of 2012 concerning the Indonesian National Qualifications Framework (KKNI);
4. Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 73 of 2013 concerning the Implementation of KKNI in Higher Education;
5. Regulation of the Minister of Research, Technology, and Higher Education of the Republic of Indonesia No. 62 of 2016 on the Higher Education Quality Assurance System;
6. Regulation of the Minister of Research, Technology, and Higher Education No. 59 of 2018 on Diplomas, Competency Certificates, Professional Certificates, Degrees, and the Procedures for Writing Degrees in Higher Education Institutions;

7. Decision of the Minister of Research, Technology, and Higher Education No. 123 of 2019 concerning Internships and Recognition of Semester Credit Units for Industrial Internships for Bachelor's and Applied Bachelor's Programs.
8. Regulation of the Minister of Education and Culture No. 3 of 2020 concerning National Standards for Higher Education;
9. Ministry of Education and Culture Regulation No. 5 of 2020 on the Accreditation of Study Programs and Higher Education Institutions
10. Ministry of Education and Culture Regulation No. 7 of 2020 on the Establishment, Amendment, and Dissolution of State Universities, and the Establishment, Amendment, and Revocation of Licenses for Private Universities.
11. Ministry of Education and Culture Regulation No. 22 of 2020 on the Strategic Plan of the Ministry of Education and Culture
12. Ministry of Education, Culture, Research, and Technology Regulation No. 53 of 2023 on Quality Assurance of Higher Education Institutions
13. Ministry of Education and Culture Regulation No. 3 of 2020 concerning national standards for higher education, as well as excerpts from the guidelines for curriculum development in higher education in the era of the 4th Industrial Revolution, published by the Directorate General of Learning and Student Affairs, Ministry of Education, Culture, Research, and Technology in 2020
14. Universitas Syiah Kuala Curriculum Development Guidelines 2023

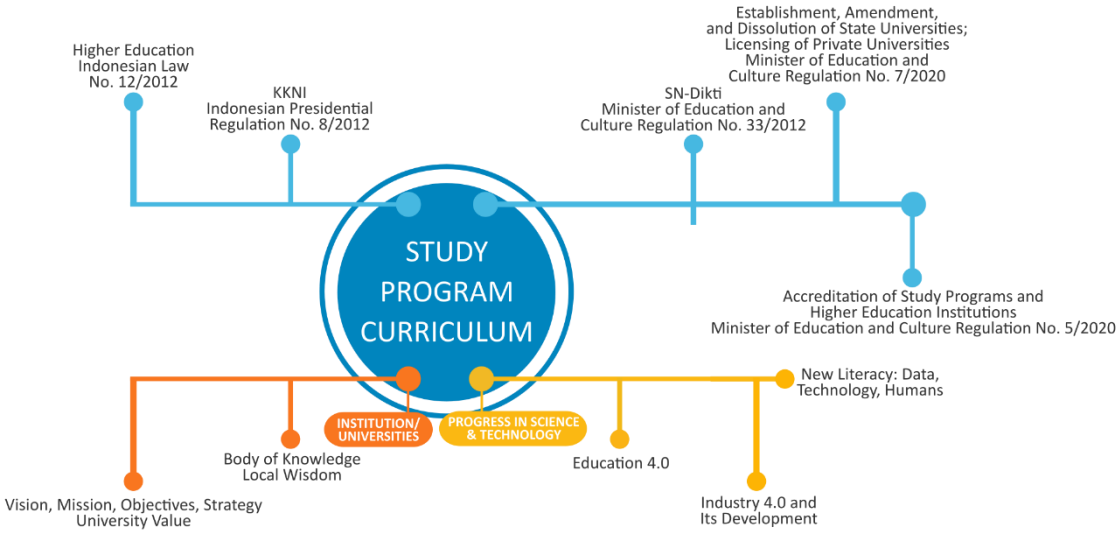


Figure 1.4. Legal Basis, National and Institutional Policies for Higher Education Curriculum Development

CHAPTER 2
SCHOLARLY VISION, OBJECTIVES and STRATEGIES OF THE STUDY PROGRAM

2.1 Scholarly Vision and Study Program Mission

2.1.1 Scholarly Vision

The academic vision of SPHY is to develop physics to produce graduates who are innovative, independent, and leading socio-science entrepreneurs at the global level by 2035. A comparison of the visions of the study program, faculty, and university and the relationship between the visions of USK and the faculty can be seen in Table 2.1 and Table 2.2.

Table 2.1 Comparison of the visions of the Study Program, Faculty, and Universitas Syiah Kuala

Vision of Bachelor in Physics	Vision of the Faculty of Mathematics and Natural Sciences	Vision of Universitas Syiah Kuala
Developing physics to produce graduates who are innovative, independent, and leading socio-science entrepreneurs at the global level by 2035.	To become a center for research and development in mathematics and science that focuses on utilizing Aceh's natural potential, through a socio-science entrepreneurial approach that is recognized as leading in Indonesia and known worldwide by 2039.	Becoming an innovative, independent, and leading socio-technopreneur university at the global level

Table 2.2 Checklist of linkages between USK/Faculty vision and study program vision

Study Program Vision Keyword	Linkage to the vision of the study program (marked √)		Description Alignment
	Faculty Vision Keywords	USK Vision Keywords	
Sosio	√	√	The innovations and products of entrepreneurs not only create added value for the business world but also benefit society.
Entrepreneur	√	√	The university and faculty work together to support students' entrepreneurial spirit by equipping them

Study Program Vision Keyword	Linkage to the vision of the study program (marked √)		Description Alignment
	Faculty Vision Keywords	USK Vision Keywords	
			with innovative skills and leadership to create added value in business and society.
Innovative	-	√	Faculties and universities work together to support students' entrepreneurial spirit with a focus on innovation, equipping them with innovative skills and leadership to add value to the business world and society.
Independent	-	√	Innovation and products from entrepreneurs not only involve the creation of new ideas, but also the process of social change that occurs when new ideas or products are accepted and used by society.
Leading	√	√	The creativity of the community is reflected in the products they produce, which not only provide local benefits but also have a global impact, making them an extraordinary contribution on an international scale.
Global	√	√	The products created by the community not only provide local benefits, but can also be utilized globally, demonstrating the widespread impact of the community's creativity and contributions.

2.1.2 Mission of the Study Program

1 Providing high-quality higher education to produce physics graduates with competencies and socio-scientific entrepreneurial insights that are highly competitive;
2 Conducting research and community service in the field of physics and its applications based on excellence, innovation, competitiveness, and sustainability in socio-science entrepreneurship;
3 Strengthening and expanding institutional cooperation networks to develop and preserve physics science and its applications; also
4 Implementing integrated quality management in academic and non-academic fields through the application of the principles of transparency, productive participation, effectiveness, and efficiency, as well as providing higher education with accountable governance.

2.2 Objectives

1. Producing physics graduates with competencies and socio-science entrepreneurial insights who are highly competitive and capable of applying USK values;
2. Conducting research and community service in the field of physics and its applications based on superior, innovative, competitive, and sustainable socio-science entrepreneurship;
3. To be an outstanding partner for national development and the advancement of physics and its applications; and
4. To implement integrated quality management in academic and non-academic fields through accountable governance.

2.3 Strategies

The strategy adopted by SPHY to achieve its objectives through activities that are clearly defined, relevant, and have a clear and measurable timeline is as follows:

1. Enhancing the quantity and quality of cooperation (MoU-PKS) with external parties in scientific activities, including student exchanges, joint research, visiting lecturers, joint seminars, and joint publications.
2. Enhancing the academic atmosphere through effective, accountable, communicative, and efficient program management.
3. Optimizing laboratory facilities and infrastructure to support high-quality research and learning.
4. Developing and strengthening Research and Community Service Groups based on expertise in specific fields of study to produce research and community service outcomes with reputable outcomes and the potential to generate intellectual property rights (HKI).

2.4 University Value

Universitas Syiah Kuala is part of the Ministry of Education and Culture, which plays an important role in realizing the mission and strategic objectives of national higher education. The USK values embraced by USK refer to the basic values of USK, as stipulated in Article 7 of Government Regulation Number 38 of 2022, namely:

1. **Pancasila**: USK emphasizes the importance of understanding, respecting, and applying the values of Pancasila in all aspects of campus life. This includes respecting differences, promoting unity, and upholding the basic principles of Pancasila in interactions between campus members.
2. **Sincerity**: USK emphasizes the importance of sincerity in various academic, social, and organizational activities. Sincerity in sharing knowledge, helping others, and performing tasks with genuine intentions are values that USK embraces and promotes.
3. **Honesty**: USK emphasizes that honesty is the cornerstone of all activities on campus. Students and campus members are expected to act honestly in all situations, whether in academic exams, research, or daily interactions.
4. **Togetherness**: USK promotes the value of togetherness as the foundation for creating a harmonious learning and development environment. Cooperation, collaboration, and solidarity among campus members are emphasized in order to achieve common goals and strengthen campus community bonds.

This slogan means that USK is determined to organize itself so that it always works in harmony, balance, and equilibrium based on faith and piety in accepting and developing science and technology, producing graduates whose dedication always brings honor to the nation and state, prosperity, welfare, and peace to humanity. The institution's aspirations are outlined in USK's VISION, which is **to become an innovative, independent, and leading socio-technopreneur university at the global level.**

CHAPTER 3
PROFILE AND FORMULATION OF GRADUATE COMPETENCY STANDARDS

3.1 Graduate Profile and Profile Description

A graduate profile is a characteristic or role that graduates can perform in a particular field of expertise or work after completing their studies. The SPHY graduate profile is determined based on an analysis of the results of a tracer study, Focus Group Discussion (FGD) on graduate competencies, stakeholders, professional associations, and alumni. From the results of these activities, four SPHY graduate profiles were formed, which are presented in Table 3.1 below:

Table 3.1 Graduate Profile (PL) Description

PL Code	Graduate Profile	Competence	Profession
PL-01	**Educator** Become an intellectual who has a good command of physics concepts and theories, is able to present research results and thoughts professionally, and is ready to continue their education to a higher level.	● Mastery of physics and its applications (PP) ● Lifelong Learning (S) ● Have a decent social character (KU) ● Ability to communicate effectively (KU)	1. Academics; Lecturers, Teachers, Instructors 2. Research Assistants, Data Analysts, 3. Entrepreneurs 4. Government/private sector employees, Consultants, Data Analysts 5. Computer Programmers
PL-02	**Research Assistant** Become a professional with a good command of physics concepts and theories, sharp analytical skills, the ability to design and conduct experiments, and the ability to manage data carefully, as well as assist in research activities in fields related to physics and its applications.	● Mastery of physics and its applications (PP) ● Lifelong Learning (S) ● Mastery of research methods and data analysis (KK) ● Understanding scientific norms (S) ● Have a decent social character (KK)	

		● Ability to communicate effectively (KU)	
PL-03	**Socio-science-technopreneur** Becoming an entrepreneur involved in science and education and able to demonstrate a professional attitude, responsibility, ethics, entrepreneurial spirit, creativity, anticipation, adaptability, initiative, and competence in performing tasks in the workplace so as to be able to compete in the era of Industry 4.0 and Society 5.0.	● Mastery of physics and its applications (PP) ● Have a decent social character (KU) ● Ability to communicate effectively (KU) ● Entrepreneurial spirit (KU)	
PL-04	**Industrial Practitioners** Becoming an employee and consultant at a government/private institution with a good command of physics concepts and theories, and the ability to apply scientific knowledge to various problems in the industrial world, such as the design and development of instrumentation and computing equipment, and the ability to compete in the era of Industry 4.0 and Social 5.0.	● Mastery of physics and its applications (PP) ● Have a decent social character (KU) ● Ability to communicate effectively (KU) ● Entrepreneurial spirit (KU)	

3.2 Elements of Intended Learning Outcomes (ILO)

Learning outcomes for graduates are a formula for achieving graduate competency standards, which are the minimum criteria for graduate qualifications covering **Attitude (A), Knowledge Mastery (KM), General Skills (GS), and Specific Skills (SS)**. The results of the analysis of job market needs and scientific development that were carried out in the first stage in the form of graduate profiles were also used as a reference for formulating intended learning outcomes. In order to establish the desired graduate profile, it is necessary to develop Intended Learning Outcomes (ILO) based on the general and specific descriptions of the level 6 qualification in the Indonesian National Qualifications Framework (KKNI) and the general qualifications for a Bachelor of Physics degree from the Physical Society of Indonesia (PSI). In addition, the ILO that was developed is also compatible with the ASIIN Technical Committee. Thus, the ILO for SPHY can be broken down into five aspects, namely:

Table 3.2 Linkage between PL and ILO

PL Code	ILO Code	ILO Description
PL-01, PL-02, PL-03, PL-04	CPL-01	Graduates demonstrate religious attitudes and good social character by applying applicable scientific norms and ethics to become lifelong learners (**S+PP**)
PL-01, PL-02, PL-04	CPL-02	Graduates are able to master theoretical concepts in physics and multidisciplinary fields related to physical phenomena by using relevant methods to solve simple physics problems accurately and systematically (**PP**)
PL-01, PL-02, PL-04	CPL-03	Graduates are able to master mathematical methods, computation, instrumentation, and digital technology (Internet of Things, artificial intelligence, and big data mining) by adapting and applying technology to solve interdisciplinary problems related to physics (**KK**)
PL-01, PL-02, PL-03, PL-04	CPL-04	Graduates are able to master applied physics concepts by applying experimental and measurement/metrology methods to disseminate information orally and in writing in accordance with standard scientific principles (**PP+KK**)
PL-01, PL-02, PL-03, PL-04	CPL-05	Graduates possess innovative, adaptive, and responsible managerial competencies, accompanied by intellectual abilities, by applying critical, logical, and independent thinking skills to work professionally and entrepreneurially (**S+PP+KU)**

3.3 Determination of Study Materials

The study material is a formulation of knowledge used to meet learning outcomes that can be measured based on indicators of mastery, breadth, and depth of scientific knowledge developed by the study program. Study materials taken from a group of sciences that characterize a particular study program or branch of science and technology needed to anticipate future science, based on market needs analysis and the professions that graduates will pursue. The depth and breadth of study materials refer to SN-DIKTI article 9, paragraph 2 SN DIKTI 2015, bachelor's degree graduates must at least master general theoretical concepts in a particular field of knowledge and skills and in-depth theoretical concepts in a specific area of knowledge and skills. Graduates of bachelor's degree programs must have a general understanding of theoretical concepts in specific fields of knowledge and skills, as well as an in-depth understanding of theoretical concepts in specific areas of knowledge and skills. Based on the ILO established above, the study materials that can meet its objectives are summarized in Table 3.3 as follows:

Table 3.3 Relationship between ILO and Study Matter

ILO Code	Code	Study Materials
CPL-01	BK-01	Religion Education, Pancasila, Civic Education, Research Methodology

ILO Code	Code	Study Materials
CPL-02	BK-02	**Classical Physics** (Introduction to Physics, Fundamental of Physics, Mechanics, Electromagnetics, Thermodynamics, Waves, and Optics, Theoretical Physics)
CPL-02	BK-03	**Modern Physics** (Quantum Physics, Atomic and Molecular Physics, Nuclear Physics, Statistical Physics, Elementary Physics, Reactor Physics)
CPL-02	BK-04	**Multidisciplinary Sciences** (Introduction to Calculus, Introduction to Chemistry, Introduction to Biology, Introduction to Statistics, Introduction to Information and Communication Technology, Remote Sensing, Geographic Information System)
CPL-03	BK-05	**Mathematical Methods** (Mathematical Physics, Algorithm and Programming, Computational Physics, Numerical Methods)
CPL-04	BK-06	**Electronics and Instrumentation** (Electronics, Instrumentation Physics, Measurement and calibration, Microelectronics, Electronics and Instrumentation Design, Server and Computer Network System, Data Communication and Telemetry, Sensors and Transducers)
CPL-02	BK-07	**Material Physics** (Solid State Physics, Metallurgy, Magnetic Materials, Semiconductor, Biomaterial, Mineral and Rock Physics, Surface Physics,
CPL-02	BK-08	**Geophysics and Atmospheric Sciences** (Introduction to Geophysics, Seismic Methods, Electromagnetic Methods, Seismology, Physical Geology, Marine Geophysics, Meteorology and Weather Forecasting, Disasters and the Environment)
CPL-02	BK-09	**Wave and Optics Application** (Optic Fiber, Laser Application, Wave Guide, Optical Communications,
CPL-02	BK-10	**Medical Physics** (Health Physics and Radiation Protection, Radiobiology, Introduction to Nuclear Medicine, Radiodiagnostic, Biophysics,
CPL-03	BK-11	**Renewable Energy** (Solar Cells, Geothermal, Hydrogen Storage, Ocean wave energy, Wind Energy)
CPL-05	BK-12	**General Skills** (Entrepreneurship, Indonesian Language, English, Internship, Community Service Program, Final Project, Research Methodology, Scientific Writing)

3.4 Formulation of Course Learning Outcomes (CLO)

Since the ILOs assigned to courses are still general in nature, they need to be broken down into course learning outcomes (CPMK) that are more specific to each course. All CPMKs in SPHY are formulated using the SMART (*Specific, Measurable, Achievable*, dan *Realistic*) criteria. The CLO formulation must contain elements of learning abilities and materials that are selected and determined in terms of depth and breadth in accordance with the ILO assigned to the course. Next, the CLO is broken down further

into several sub-learning outcomes for each course (Sub-CPMK). Sub-CPMK as the final competency planned at each stage of learning to meet ILO. The ILO description assigned to the course becomes CPMK, then is further broken down into sub-CPMK and must be constructive alignment.

3.5 Formation of Courses

After compiling the course materials, the next step is to develop the course. This course was developed by grouping together related subjects and then giving each group a name. Then, equivalent study material groups are presented in courses that ensure that the study material can achieve the ILO, which is then followed by determining the credit weight of each course.

The number of credits for a course is defined as the time required for students to acquire the skills outlined in the course. The factors determining the number of credits are: (a) the level of proficiency to be achieved, (b) the depth and breadth of the learning material, and (c) the learning strategy.

Table 3.4. Determination of Course Credits

Code	**Course Name**	***Number of CLO***	**Estimation of student study load time**		**SKS**
			Theory	**Practicum**	
MKWU1002	Civic Education	4	5,6 hours/week for 16 weeks = 90,5 hours	0	2
MKWU1005	Disaster Management and Environment	4	5,6 hours/week for 16 weeks = 90,5 hours	0	2
MKWU1006	Character Building I	1	0	0	0
SMPA1001	Introduction to Calculus	2	8,5 hours/ week for 16 weeks = 135,8	0	3
SMPA1003	Introduction to Physics	6	5,6 hours/ week for 16 weeks = 90,5	0	2
SPHY1001	Practicum of Introduction to Physics	4	0	2,83 hours/week for 16 weeks = 45,28	1
SMPA1005	Introduction to Chemistry	2	5,6 hours/week for 16 weeks = 90,5	0	2
SMKM1001	Practicum of Introduction to Chemistry	1	0	2,83 hours/week for 16 weeks = 45,28	1
SMPA1007	Introduction to Biology	4	5,6 hours/week for 16 weeks = 90,5	0	2

Code	Course Name	*Number of CLO*	Estimation of student study load time		SKS
			Theory	Practicum	
SMBI1001	Practicum of Introduction to Biology	*4*	0	2,83 hours/week for 16 weeks = 45,28	1
SMPA1011	Statistical Methods	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SMPA1009	Introduction to Industrial Revolution	*2*	5,6 hours/week for 16 weeks = 90,5	0	2
MKWU1001	Pancasila	*6*	5,6 hours/week for 16 weeks = 90,5	0	2
MKWU1003	Indonesian Language	*6*	5,6 hours/week for 16 weeks = 90,5	0	2
MKWU1004	English	*6*	5,6 hours/week for 16 weeks = 90,5	0	2
MKWU1007	Character Building II	*0*	0	0	0
SPHY1002	Occupational Health and Safety	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY1004	Fundamental of Physics	*4*	11,3 hours/week for 16 weeks = 181	0	4
SPHY1006	Practicum of Fundamental of Physics	*4*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY1008	Calculus of Physics	*6*	11,3 hours/week for 16 weeks = 181	0	4
SPHY1010	Measurement and Calibration	*5*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY1012	Practicum Measurement and Calibration	*4*	0	2,83 hours/week for 16 weeks = 45,28	1
MKWU2001	Religion Education	*5*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY2003	Mathematical Physics I	*4*	11,3 hours/week for 16 weeks = 181	0	4
SPHY2003	Modern Physics	*5*	8,5 hours/week for 16 weeks = 135,8	0	3
SPHY2005	Thermodynamics	*3*	8,5 hours/week for 16 weeks = 135,8	0	3

Code	Course Name	*Number of CLO*	Estimation of student study load time		SKS
			Theory	Practicum	
SPHY2007	Practicum of Thermodynamics	*4*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY 2009	Electronics	*5*	8,5 hours/week for 16 weeks = 135,8	0	3
SPHY 2011	Practicum of Electronics	*4*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY 2013	Algorithm and Programming	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY 2015	Practicum of Algorithm and Programming	*4*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY2014	Mathematical Physics II	*7*	11,3 hours/week for 16 weeks = 181	0	4
SPHY2016	Waves	*4*	8,5 hours/week for 16 weeks = 135,8	0	3
SPHY2018	Practicum of Waves	*3*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY2020	Electromagnetics	*4*	8,5 hours/week for 16 weeks = 135,8	0	3
SPHY2022	Practicum of Electromagnetics	*3*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY2024	Mechanics	*4*	11,3 hours/week for 16 weeks = 181	0	4
SPHY2026	Computational Physics	*4*	8,5 hours/week for 16 weeks = 135,8	0	3
SPHY2028	Practicum of Computational Physics	*3*	0	2,83 hours/week for 16 weeks = 45,28	1
SMPA3013	Entrepreneurship	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SMPA3015	Practicum Entrepreneurship	*4*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY3017	Optics	*5*	8,5 hours/week for 16 weeks = 135,8	0	3
SPHY3019	Practicum of Optics	*4*	0	2,83 hours/week for 16 weeks = 45,28	1

Code	Course Name	*Number of CLO*	Estimation of student study load time		SKS
			Theory	Practicum	
SPHY3021	Statistical Physics	*3*	8,5 hours/week for 16 weeks = 135,8	0	3
SPHY3023	Quantum Physics	*4*	11,3 hours/week for 16 weeks = 181	0	4
SPHY3030	Nuclear Physics	*4*	8,5 hours/week for 16 weeks = 135,8	0	3
SPHY3032	Research Methodology	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY3034	Solid State Physics	*5*	11,3 hours/week for 16 weeks = 181	0	4
MKWUP001	Community Service Program	*3*	0	5,6 hours/week for 16 weeks = 90,5	2
SMPAP002	Research Proposal	*4*	0	5,6 hours/week for 16 weeks = 90,5	2
SMPAP001	Internship	*4*	8,5 hours/week for 16 weeks = 135,8	0	3
SPHY 4075	Scientific Writing	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SMPAPA02	Final Project	*5*	11,3 hours/week for 16 weeks = 181	0	4
SPHY6025	Geographic Information System	*5*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6027	Practicum of Geographic Information System	*4*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY6029	Electromagnetic Methods	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6031	Vulcanology and Geothermal	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6033	Physical Geology	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6035	Biomaterial	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6037	Material Science	*4*	8,5 hours/week for 16 weeks = 135,8	0	3

Code	Course Name	*Number of CLO*	Estimation of student study load time		SKS
			Theory	Practicum	
SPHY6039	Semiconductor	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6041	Composite Physics	*7*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6043	Geometrical Optics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6045	Physical Optics	*5*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6047	Acoustics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6049	Photonics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6051	Light and Color	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6053	Particle Physics	*5*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6055	Introduction to Radiological Physics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6057	Practicum Introduction to Radiological Physics	*3*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY6059	Anatomy and Physiology	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6061	Reactor Physics	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6063	Dosimetry and Radiation Protection	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6065	Biophysics	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SMPAP003	Entrepreneurial Practice	*5*	0	48,11 hours/week for 16 weeks = 770	17
SMPAP005	Industrial Internship A	*5*	0	48,11 hours/week for 16 weeks = 770	17
SPHY6067	Electronics and Instrumentation Design	*5*	5,6 hours/week for 16 weeks = 90,5	0	2

Code	Course Name	*Number of CLO*	Estimation of student study load time		SKS
			Theory	Practicum	
SPHY6069	Practicum of Electronics and Instrumentation Design	*4*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY6071	Sensors and Transducers	*5*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6073	Practicum Sensors and Transducers	*4*	0	2,83 hours/week for 16 weeks = 45,28	1
SMPAP004	Scientific Publication	*5*	0	31,13 hours/week for 16 weeks = 498,1	11
SMPAP006	Industrial Internship B	*5*	0	31,13 hours/week for 16 weeks = 498,1	11
SPHY6036	Introduction to Geophysics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6038	Potential Field Survey	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6040	Seismic Methods	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6042	Geotechnics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6044	Mineral and Rock Physics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6046	Remote Sensing	*5*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6048	Practicum of Remote Sensing	*4*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY6050	Special Topic of Geophysics	*5*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6052	Renewable Energy	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6054	Material Characterization	*6*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6056	Practicum of Material Characterization	*3*	0	5,6 hours/week for 16 weeks = 90,5	2
SPHY6058	Ceramic Physics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2

Code	Course Name	*Number of CLO*	Estimation of student study load time		SKS
			Theory	Practicum	
SPHY6060	Solar Cells	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6062	Introduction to Optoelectronics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6064	Instrument Optics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6066	Laser and Spectroscopy Experiments	*3*	0	5,6 hours/week for 16 weeks = 90,5	2
SPHY6068	Optical Communications	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6070	Basics Optometry	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6072	Introduction to Radiotherapy	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6074	Radiobiology	*5*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6076	Introduction to Nuclear Medicine	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6078	Physics of Medical Imaging	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6080	Server and Computer Network System	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6082	Practicum of Server and Computer Network System	*3*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY6084	Embedded Electronic System	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6086	Practicum of Embedded Electronic System	*3*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY6088	Medical Instrumentation	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6090	Practicum of Medical Instrumentation	*3*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY6077	Meteorology and Weather Modeling	*4*	5,6 hours/week for 16 weeks = 90,5	0	2

Code	Course Name	*Number of CLO*	Estimation of student study load time		SKS
			Theory	Practicum	
SPHY6079	Data Analysis and Geophysics Modeling	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6081	Seismology	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6083	Field Geophysics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6085	Geophysics and Meteorology Instrumentation	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6087	Nano Materials	*5*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6089	Magnetic Materials	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6091	Corrosion	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6093	Laser	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6095	Optical Instrumentation	*5*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6097	Spectroscopy	*5*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6099	Radiometry	*4*	0	5,6 hours/week for 16 weeks = 90,5	2
SPHY6101	Photometry	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6103	Theoretical Physics Methods	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6105	Artificial Intelligence	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6107	Analytical Mechanics	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6109	Radiotherapy Planning	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6111	Introduction to Biomedical Engineering	*4*	5,6 hours/week for 16 weeks = 90,5	0	2

Code	Course Name	*Number of CLO*	Estimation of student study load time		SKS
			Theory	Practicum	
SPHY6113	Astronomy	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SMPAP008	Village Project B	*5*	0	34 hours/week for 16 weeks = 544	12
SMPAP009	Science Teaching Practice A	*6*	0	51 hours/week for 16 weeks = 816	18
SPHY6115	Internet of Things (IoT)	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6117	Practicum of Internet of Things (IoT)	*3*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY6119	Data Communication and Telemetry	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6121	Practicum of Data Communication and Telemetry	*3*	0	2,83 hours/week for 16 weeks = 45,28	1
SPHY6123	Control System and Mechatronics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6125	Practicum of Control System and Mechatronics	*3*	0	2,83 hours/week for 16 weeks = 45,28	1
SMPAP007	Village Project A	*6*	0	51 hours/week for 16 weeks = 816	18
SMPAP010	Science Teaching Practice B	*5*	0	34 hours/week for 16 weeks = 544	12
SPHY6092	Photography and Videography Optics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6094	Laser Semiconductor	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6096	Numerical Methods	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6098	Electrodynamics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6100	Relativity Physics	*3*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6102	Bioelectronics	*4*	5,6 hours/week for 16 weeks = 90,5	0	2

Code	Course Name	*Number of CLO*	Estimation of student study load time		SKS
			Theory	Practicum	
SPHY6104	Signal Processing	*4*	5,6 hours/week for 16 weeks = 90,5	0	2
SPHY6106	Practicum of Signal Processing	*3*	5,6 hours/week for 16 weeks = 90,5	0	2

**The SKS weight per course is calculated; SKS weight (Total Estimated Time) x 1 SKS / (2.83 Hours/Week x 16 Weeks) = 45.28 hours, so 134.4 hours / 45.28 hours = 2.97, which is rounded up to 3 SKS. 1 SKS = 1.6 ECTS*

Table 3.5 Relationship between CLO and Courses for Semester 1 and 2

CLO Code	CLO Description	Course Code	Course Name
MKWKW01	Students are able to explain the state and system of government, national identity, and analyze citizenship issues by demonstrating a humanistic attitude, integrity, and respect for diversity, as well as being able to cooperate and communicate well.	MKWU1002	Civic Education
MKWKW02	Students are able to analyze issues occurring in society by implementing democratic principles and constitutional values in national and state life, demonstrating the application of USK values.		
MKWKW03	Students are able to explain politics and citizenship systems and apply human rights and anti-corruption concepts in daily interactions, demonstrating the ability to collaborate and communicate effectively to achieve peace, justice, and resilient institutions.		
MKWKW04	Students are able to analyze the implementation of the Nusantara perspective and national resilience concepts to		

CLO Code	CLO Description	Course Code	Course Name
	achieve peace, justice, and resilient institutions.		
MKWUL01	Students are able to analyze the basic concepts of disaster risk reduction and demonstrate USK characteristics as well as the ability to work together and communicate well.	MKWU1005	Disaster Management and Environment
MKWUL02	Students are able to analyze the basic concepts of environmental conservation and demonstrate a humanistic attitude as well as the ability to work together and communicate well, thereby contributing to climate change mitigation.		
MKWUL03	Students are able to design simple contingency plans as a crucial step in dealing with disasters, taking into account local wisdom and applying it to community life.		
MKWUL04	Students are able to design simple projects as efforts to prevent environmental damage and enhance environmental sustainability, thereby contributing to climate change mitigation.		
MKWUPK1	Students have religious character and spirit and are able to read the Quran using the integrated Iqro method.	MKWU1006	Character Building I
CPMK011	Students have independent laboratory skills (lab skills) and are able to operate laboratory equipment (microscopes).	SMBI1001	Practicum of Introduction to Biology
CPMK012	Students are able to observe, analyze, and describe the structure and function of cells.		
CPMK013	Students are able to understand and explain the frequency of recessive genes.		
CPMK014	Students are able to observe, analyze, tabulate, and describe		

CLO Code	CLO Description	Course Code	Course Name
	the structure and function of living things.		
CPPS03	Students are skilled in performing laboratory procedures, using simple equipment in chemistry, applying safety and security standards, and managing materials, equipment, and chemistry laboratories.	SMKM1001	Practicum of Introduction to Chemistry
CPMKM01	Students are able to explain and determine fundamental concepts in mathematics, such as real numbers, exponents and roots, logarithms, algebraic and rational forms, equations, inequalities, absolute values, Cartesian coordinates, circle equations, linear equations, as well as construct and interpret graphical representations of equations.	SMPA1001	Introduction to Calculus
CPMKM02	Students are able to explain basic concepts of functions and determine aspects related to functions, including limits and continuity.		
CPMKF01	Students are able to explain and solve problems related to Units, Quantities, Vectors, and Kinematics (motion in one, two, and three dimensions).	SPHY1003	Introduction to Physics
CPMKF02	Students are able to explain and solve problems in Dynamics (Force, Pressure, and Energy).		
CPMKF03	Students are able to explain and solve problems in Dynamics (Momentum and Center of Mass).		
CPMKF04	Students are able to explain and solve problems in Simple Harmonic Motion.		

CLO Code	CLO Description	Course Code	Course Name
CPMKF05	Students are able to explain and solve problems in Rotation, Rigid Bodies, Elasticity, and Gravitation.		
CPMKF06	Students are able to explain and solve problems in Fluid Mechanics.		
CPMKK01	Students are able to explain the concepts of atoms, molecules, molecular orbitals, chemical bonds, the periodic table, and the properties of elements.	SMPA1005	Introduction to Chemistry
CPMKK02	Students are able to explain concepts and perform calculations related to the fundamentals of chemistry.		
CPMKW71	Students are able to study and describe the structure, function, and metabolism of cells.	SMPA1007	Introduction to Biology
CPMKW72	Students are able to study and describe classical and modern genetics.		
CPMKW73	Students are able to study and describe the structure and function of plant and animal organs.		
CPMKW74	Students are able to describe and identify the basic principles of ecology and biosystematics of living things.		
CPMK1	Students are able to understand the core concepts and technologies underlying the Fourth Industrial Revolution.	SMPA1009	Introduction to Industrial Revolution
CPMK2	Students are able to analyze its impact on various economic, social, and environmental aspects.		
CPMK3	Students are able to develop digital skills and the ability to innovate in the context of		

CLO Code	CLO Description	Course Code	Course Name
CPMKS01	Students are able to understand basic mathematical concepts in studying statistics.	SMPA1011	Statistical Methods
CPMKS02	Students are able to explain the concepts, theoretical foundations, and discourse that form the basis for the use of data and statistics.		
CPMK01	Students have basic knowledge and skills about measuring instruments and correct measurement techniques	SPHY1001	Practicum of Introduction to Physics
CPMK02	Students have critical thinking skills related to understanding the basic concepts of physical science		
CPMK03	Students have the ability of science process skills		
CPMK04	Students understand the basic concepts of measurement and units, the concept of motion and displacement, GLBB, Newton's Law, friction, momentum and collision, simple harmonic motion, elasticity, and fluids		
MWKWP01	Students have a mindset, attitude, and behavior that reflect the implementation of Pancasila values in social, national, and national life.	MKWU1001	Pancasila
MWKWP02	Students are able to identify various problems and solve problems in social life based on the ethical and moral values of Pancasila.		
MWKWP03	Students exhibit attitudes and behaviors consistent with the values of Pancasila.		
MWKWP04	Students are able to make appropriate decisions as alternative solutions to various issues in social, national, and state life in accordance with the		

CLO Code	CLO Description	Course Code	Course Name
	principles and values of Pancasila.		
MKWKI01	Students are able to explain the essence, position, function, and attitude of using the Indonesian language.	MKWU1003	Indonesian Language
MKWKI02	Students are able to use spelling, diction, affixation, reduplication, and composition in Indonesian writing.		
MKWKI03	Students are able to use sentence elements correctly and properly, and are able to write and develop paragraphs in Indonesian.		
MKWKI04	Students are able to write letters, scientific papers, and technical reports in proper and correct Indonesian.		
MKWUN01	Students are able to understand the TOEFL concepts related to Listening skills	MKWU1004	English
MKWUN02	Students are able to understand the TOEFL concepts related to Reading skills		
MKWUN03	Students are able to understand the TOEFL concepts related to language components (Structure and written expression)		
MKWUN04	Students are able to practice speaking skills (Communication Skill) integrated into TOEFL instruction		
MKWUPK2	Students possess character values and religious spirit, and apply them through proper Islamic attitudes and behavior in line with USK values and the implementation of Islamic law in Aceh.	MKWU1007	Character Building II
MKWUPK3	Students are able to understand and practice worship as a manifestation of true Islamic		

CLO Code	CLO Description	Course Code	Course Name
	understanding in accordance with the Qur'an and Sunnah.		
CPMK05	Students are able to plan the implementation of K3 principles in the workplace.	SPHY1002	Occupational Health and Safety (K3)
CPMK06	Students are able to implement K3 principles in the workplace.		
CPMK07	Students are able to evaluate the implementation of K3 principles in the workplace.		
CPMK08	Students are able to explain the basic concepts of thermodynamics	SPHY1004	Fundamental of Physics
CPMK09	Students are able to explain the basic concepts of electricity and electric field		
CPMK10	Students are able to explain the basic concepts, magnetism, and AC electricity		
CPMK11	Students are able to explain the basic concepts of optics and modern physics		
CPMK12	Students have knowledge and skills about measuring instruments and correct measurement techniques	SPHY1006	Practicum of Fundamental of Physics
CPMK13	Students have critical thinking skills related to understanding the basic concepts of physical science		
CPMK14	Students have the ability of science process skills		
CPMK15	Students understand the concepts of thermometry, thermal properties of materials, the laws of thermodynamics, the concept of charge, static and dynamic electricity, magnetism, electromagnetic induction, waves and optics		
CPMK16	Students are able to understand the concept of differential and apply it to determine slope,	SPHY1008	Calculus Physics

CLO Code	CLO Description	Course Code	Course Name
	determine critical points on a curve (maximum and minimum), determine monotony and curvature and draw curves from a function		
CPMK17	Students are able to understand the concept of definite integral and apply it in the calculation of flat area, volume in a plane and rotating objects, Students are able to understand the concept of transcendent functions and solve problems related to transcendent functions		
CPMK18	Students are able to master various integrating techniques, including integrating by substitution, trigonometric integrals, rationalizing substitutions, partial integrals and integrating rational functions.		
CPMK19	Students are able to recognize the form of indefinite integrals and improper integrals		
CPMK20	Students are able to understand numerical methods and approximation		
CPMK22	Students are able to explain the basic concepts of measurement systems and their elements as well as the concept of measurement uncertainty	SPHY1010	Measurement and Calibration
CPMK23	Students are able to formulate static and dynamic characteristics of a measuring instrument		
CPMK24	Students are able to explain the working principles of commonly used measuring instruments		
CPMK25	Students are able to explain calibration methods for		

CLO Code	CLO Description	Course Code	Course Name
	commonly used measuring instruments		
CPMK27	Students are able to use statistical methods as instruments to monitor measurement or test results	SPHY1012	Practicum of Measurement and Calibration
CPMK28	Students have the skills to use various types of measuring instruments, both physical quantities and electrical quantities, properly and correctly		
CPMK29	Students are able to perform calibration techniques on measurement systems; check the accuracy/suitability of measuring instruments, and determine measurement traceability		

Table 3.6 Course names and their relevance to ILO

Code	Course Name	ILO Code (Checked "√" on the appropriate ILO component)				
		CPL1	CPL2	CPL3	CPL4	CPL5
MKWU1002	Civic Education	√				
MKWU1005	Disaster Management and Environment		√			
MKWU1006	Character Building I	√				√
SMPA1001	Introduction to Calculus		√			
SMPA1003	Introduction to Physics		√			
SPHY1001	Practicum of Introduction to Physics	√		√		
SMPA1005	Introduction to Chemistry		√			
SMKM1001	Practicum of Introduction to Chemistry		√		√	
SMPA1007	Introduction to Biology		√			
SMBI1001	Practicum of Introduction to Biology				√	
SMPAP001	Statistical Methods		√			
SMPA1009	Introduction to Industrial Revolution		√			
MKWU1001	Pancasila	√				
MKWU1003	Indonesian Language	√				√
MKWU1004	English	√				√

MKWU1007	Character Building II	√				√
SPHY1002	Occupational Health and Safety					√
SPHY1004	Fundamental of Physics		√			
SPHY1006	Practicum of Fundamental of Physics	√		√		
SPHY1008	Calculus of Physics		√			
SPHY1010	Measurement and Calibration			√		
SPHY1012	Practicum Measurement and Calibration				√	
MKWU2001	Religion Education	√				
SPHY2003	Mathematical Physics I			√		
SPHY2005	Modern Physics		√			
SPHY2005	Thermodynamics		√			
SPHY2007	Practicum of Thermodynamics		√		√	
SPHY2009	Electronics		√		√	
SPHY 011	Practicum of Electronics	√			√	
SPHY2013	Algorithm and Programming	√	√	√		
SPHY2015	Practicum of Algorithm and Programming	√		√	√	
SPHY2014	Mathematical Physics II			√		
SPHY2016	Waves	√	√			
SPHY2018	Practicum of Waves		√		√	
SPHY2020	Electromagnetics		√			
SPHY2022	Practicum of Electromagnetics				√	
SPHY2024	Mechanics		√	√		
SPHY2026	Computational Physics	√	√	√		
SPHY2028	Practicum of Computational Physics	√		√	√	
SMPA3013	Entrepreneurship	√	√	√		√
SMPA3015	Practicum Entrepreneurship					√
SPHY3017	Optics		√			
SPHY3019	Practicum of Optics				√	
SPHY3021	Statistical Physics		√			
SPHY3023	Quantum Physics	√	√			
SPHY3030	Nuclear Physics		√			
SPHY3032	Research Methodology		√		√	
SPHY3034	Solid State Physics		√			
MKWUP001	Community Service Program	√				√
SMPAP002	Research Proposal		√	√		
SMPAP001	Internship					√
SPHY 4075	Scientific Writing	√			√	
SMPAPA01	Final Project	√	√	√	√	
SPHY6025	Geographic Information System		√	√		

SPHY6027	Practicum of Geographic Information System			√	√	
SPHY6029	Electromagnetic Methods	√			√	
SPHY6031	Vulcanology and Geothermal		√		√	
SPHY6033	Physical Geology	√			√	
SPHY6035	Biomaterial		√			
SPHY6037	Material Science		√		√	
SPHY6039	Semiconductor		√	√	√	
SPHY6041	Composite Physics	√	√			
SPHY6043	Geometrical Optics	√	√	√		
SPHY6045	Physical Optics		√			
SPHY6047	Acoustics		√			
SPHY6049	Photonics		√			
SPHY6051	Light and Color		√			
SPHY6053	Particle Physics	√	√			
SPHY6055	Introduction to Radiological Physics		√			
SPHY6057	Practicum Introduction to Radiological Physics				√	
SPHY6059	Anatomy and Physiology	√	√	√		
SPHY6061	Reactor Physics	√	√			
SPHY6063	Dosimetry and Radiation Protection		√	√		
SPHY6065	Biophysics		√			
SMPAP003	Entrepreneurial Practice		√			√
SMPAP005	Industrial Internship A				√	√
SPHY6067	Electronics and Instrumentation Design				√	
SPHY6069	Practicum of Electronics and Instrumentation Design	√			√	
SPHY6071	Sensors and Transducers	√	√	√		
SPHY6073	Practicum Sensors and Transducers		√		√	
SMPAP004	Scientific Publication				√	
SMPAP006	Industrial Internship B				√	√
SPHY6036	Introduction to Geophysics	√	√			
SPHY6038	Potential Field Survey	√			√	
SPHY6040	Seismic Methods	√	√	√		
SPHY6042	Geotechnics				√	
SPHY6044	Mineral and Rock Physics			√		
SPHY6046	Remote Sensing		√	√		
SPHY6048	Practicum of Remote Sensing			√		
SPHY6050	Special Topic of Geophysics		√		√	
SPHY6052	Renewable Energy				√	
SPHY6054	Material Characterization		√			
SPHY6056	Practicum of Material Characterization				√	

SPHY6058	Ceramic Physics		√			
SPHY6060	Solar Cells		√			
SPHY6062	Introduction to Optoelectronics		√			
SPHY6064	Instrument Optics				√	
SPHY6066	Laser and Spectroscopy Experiments	√	√			
SPHY6068	Optical Communications		√			
SPHY6070	Basics Optometry		√			
SPHY6072	Introduction to Radiotherapy	√	√			
SPHY6074	Radiobiology		√	√		
SPHY6076	Introduction to Nuclear Medicine	√	√			
SPHY6078	Physics of Medical Imaging			√		
SPHY6080	Server and Computer Network System		√		√	
SPHY6082	Practicum of Server and Computer Network System	√			√	
SPHY6084	Embedded Electronic System	√			√	
SPHY6086	Practicum of Embedded Electronic System	√			√	
SPHY6088	Medical Instrumentation	√			√	
SPHY6090	Practicum of Medical Instrumentation				√	
SPHY6077	Meteorology and Weather Modeling		√	√		
SPHY6079	Data Analysis and Geophysics Modeling	√		√		
SPHY6081	Seismology	√	√	√	√	
SPHY6083	Field Geophysics	√	√			
SPHY6085	Geophysics and Meteorology Instrumentation		√		√	
SPHY6087	Nano Materials				√	
SPHY6089	Magnetic Materials	√			√	
SPHY6091	Corrosion		√			
SPHY6093	Laser	√	√			
SPHY6095	Optical Instrumentation				√	
SPHY6097	Spectroscopy	√	√			
SPHY6099	Radiometry	√	√			
SPHY6101	Photometry	√	√	√		
SPHY6103	Theoretical Physics Methods		√			
SPHY6105	Artificial Intelligence			√		
SPHY6107	Analytical Mechanics		√			
SPHY6109	Radiotherapy Planning		√			
SPHY6111	Introduction to Biomedical Engineering		√			
SPHY6113	Astronomy		√			
SMPAP008	Village Project B					√

SMPAP009	Science Teaching Practice A				√	
SPHY6115	Internet of Things (IoT)				√	
SPHY6117	Practicum of Internet of Things (IoT)	√			√	
SPHY6119	Data Communication and Telemetry				√	
SPHY6121	Practicum of Data Communication and Telemetry	√			√	
SPHY6123	Control System and Mechatronics	√			√	
SPHY6125	Practicum of Control System and Mechatronics	√			√	
SMPAP007	Village Project A					√
SMPAP010	Science Teaching Practice B					√
SPHY6092	Photography and Videography Optics		√			√
SPHY6094	Laser Semiconductor		√			
SPHY6096	Numerical Methods			√		
SPHY6098	Electrodynamics		√			
SPHY6100	Relativity Physics		√			
SPHY6102	Bioelectronics	√			√	
SPHY6104	Signal Processing		√		√	
SPHY6106	Practicum of Signal Processing	√			√	

Table 3.7. Description of Study Materials

Code	Study Materials/Course Name	Description
MKWU2001	Religion Education	This course covers attitudes, knowledge, and skills based on critical thinking, analysis, and problem solving regarding human nature and religion, the main sources of Islamic teachings, the basic framework of Islamic teachings, and other Islamic insights.

Code	Study Materials/Course Name	Description
MKWU1001	Pancasila	Pancasila as a group of Compulsory Curriculum Subjects (MKWK) serves as an orientation for students in explaining and strengthening their views and personality development regarding Pancasila as the ideology of the Indonesian nation as seen from the perspective of Indonesian history, as the foundation of the Unitary State of the Republic of Indonesia, and as a philosophical and ethical system in the development of science.
MKWU1002	Civic Education	This Civic Education course is an introduction to the nature of Civic Education, followed by discussions on national identity; national integration; the constitution; the obligations and rights of the state and citizens; law enforcement and human rights; democracy; the archipelagic concept; anti-corruption; and national resilience.
MKWU1003	Indonesian Language	The Indonesian Language General Course is a compulsory course that must be taken by all students. This course is designed to strengthen students' character, among other things. The scope of the material covered in this course includes the history of the development of the Indonesian language, the role and function of the Indonesian language, general guidelines for Indonesian spelling, word formation processes, word choice, effective sentences and sentence structure, paragraphs and their development patterns, academic papers, popular academic papers, understanding academic books, exploring the world of libraries, and writing official letters.
MKWU1004	English	This course is designed to equip students with the skills and strategies necessary to succeed in the TOEFL exam. The emphasis on TOEFL is intended to help students achieve the TOEFL scores required for both academic and professional purposes in the future. This course is offered to all first- and second-semester students at Universitas Syiah Kuala to help them understand the concepts of listening, reading, and language components such as structure and written expression, while integrating speaking skills (Communication Skills) into the curriculum.

Code	Study Materials/Course Name	Description
MKWU1005	Disaster Management and Environment	The General Course on Disaster Management and Environment (MKU PKL) is a concrete step taken by Universitas Syiah Kuala since 2016 to enhance the capacity of human resources with strong character to actively contribute to post-2004 Tsunami disaster risk reduction efforts. This course aims to equip students with foundational humanities skills to address the evolving challenges of Disaster Management and Environment. Additionally, the MKU PKL seeks to guide the development of character traits in students, enabling them to take on roles in resolving various issues related to Disaster Management and Environment.
SMPA1001	Introduction to Calculus	The Introduction to Calculus course is designed to help students solve simple mathematical problems logically, systematically, and creatively, and to think critically using basic mathematical concepts, formulas, methods, and reasoning. This course equips students with concepts of functions and their operations, limits, derivatives, and integrals. The course material places greater emphasis on techniques for solving real-world problems that can be formulated into functions of a single independent variable. As a result, students are expected to be able to apply logical, critical, systematic, and innovative thinking in the context of developing or implementing science and/or technology in accordance with their field of expertise.
SMPA1005	Introduction to Chemistry	The Introduction to Chemistry course covers the properties of matter and its changes, atomic and molecular structures, the periodic table and its periodic properties, stoichiometric calculations, chemical bonds, chemical equilibrium and solutions, and concentration calculations. The competencies aimed to be achieved through this course are for students to master and understand facts, concepts, principles, and main theories, and to apply logical, critical, systematic, and innovative thinking in the context of developing or implementing science and technology that considers and applies values consistent with the field of chemistry. Additionally, students will be skilled in handling chemicals safely, including understanding their physical and chemical properties and the specific hazards that may arise from their use.

Code	Study Materials/Course Name	Description
SMKM1001	Practicum of Introduction to Chemistry	This Introduction to Chemistry Practicum aims to provide further understanding of basic concepts and practices. In this course, students are introduced to laboratory equipment, laboratory safety, basic filtration techniques, solution preparation, thermochemistry, chemical equilibrium, and basic reactions such as ionic reactions, acid-base reactions, and redox reactions. Additionally, students are introduced to the proper handling of chemical substances, chemical waste, and laboratory equipment, with a focus on safety and environmental protection.
SMPA1007	Introduction to Biology	The Introduction to Biology course explains the concepts and fundamentals of biology. In general, this course covers scientific processes and methods of life, the scope of biology, the structure and function of cell reproduction and respiration, and photosynthesis. It also covers classical and modern genetics, the structure and function of plant and animal organs, the biosystematics of living things, and ecology.
SMBI1001	Practicum of Introduction to Biology	This course aims to train basic skills in working in laboratories and scientific methods in studying biology both in laboratories and in the field, as well as techniques for communicating the results of investigations of biological objects and issues, as well as biological scientific methodology. Thus, students will have basic skills in solving biological problems based on scientific attitudes and procedures.
SMPA1003	Introduction to Physics	The Introduction to Physics course teaches about the concepts or laws of physics that apply in nature. In general, the course material covers Quantities and Units, Measurement, Linear Motion, Circular Motion, Force and Pressure, Newton's First Law (Equilibrium), Newton's Second Law and Newton's Third Law, Momentum, Work and Energy, Rotation of Rigid Bodies, Gravity, Vibration (Simple Harmonic Motion, Basic Elasticity), and Fundamentals of Fluid Mechanics (Static and Dynamic).

Code	Study Materials/Course Name	Description
SPHY1001	Practicum of Introduction to Physics	This course consists of practical activities designed to provide students with a deep understanding of the theories and basic concepts of physics discussed in the Introduction to Physics lecture series. This practical course includes a series of experiments designed to develop the practical skills, observation, and data analysis skills required in the context of an introduction to physics. Students will be encouraged to think critically, develop analytical skills, and apply fundamental physics concepts in real-world scenarios.
SMPAP001	Statistical Methods	The Statistical Methods course provides a foundation for understanding qualitative and quantitative methods related to the field of statistics. Course material covers descriptive and inferential statistics. An introduction to the Minitab, R, and SPSS programs is provided as tools to assist in solving simple problems related to data processing and analysis. Through this course, students are expected to master theoretical concepts and fundamental principles, as well as understand the application of Statistical Methods in research using statistical software.
SMPA1009	Introduction to Industrial Revolution	This course is designed to provide an overview of the industry and its developments. The course material focuses on digital technology from the last decade to a whole new level with the help of interconnectivity through the Internet of Things (IoT), access to real-time data, and the introduction of cyber-physics systems. This course offers a more comprehensive, interconnected, and holistic approach to manufacturing. Students are expected to leverage instant data to enhance productivity, improve processes, and drive industrial growth.
SPHY1002	Occupational Health and Safety (K3)	This course covers the definition and terminology of safety, causes of accidents, the definition of K3, regulations related to K3, Occupational Safety and Health Management Systems, Personal Protective Equipment, Occupational Safety and Health Committee (RK3K), Environmental Management Systems, Occupational Safety and Health in Construction Work, Occupational Safety and Health in Scaffolding, Occupational Safety and Health in Mechanical and Electrical Work, Occupational Safety and Health in Fire Suppression Systems, Occupational Safety and

Code	Study Materials/Course Name	Description
		Health Inspections in Construction, and Work Accident Analysis.
SPHY1004	Fundamental of Physics	The Fundamentals of Physics course teaches the concepts and laws of physics that apply in nature. Broadly speaking, the course material covers Temperature and Heat, Thermal Properties of Matter, Laws of Thermodynamics, Electricity and Magnetism, Electromagnetic Waves, Properties and Propagation of Waves, Optics, Interference and Diffraction, Theory of Relativity, and Atomic Theory.
SPHY1006	Practicum of Fundamental of Physics	This course consists of practical activities designed to provide students with a deep understanding of the theories and concepts of physics discussed in the Fundamental of Physics lecture series. This practical course includes a series of experiments designed to develop the practical skills, observation, and data analysis skills required in the context of physics. Students will be encouraged to think critically, develop analytical skills, and apply physics concepts in real-world contexts.
SPHY1008	Calculus of Physics	The Calculus of Physics course is designed to provide students with the skills to solve simple physics problems using mathematical concepts such as derivatives, integrals, transcendental functions, numerical methods, and approximations. Examples of the physics problems include determining the slope, critical points, monotonicity, and concavity of a curve, and plotting the curve of a function. Other problems include calculating the area of a plane, volume within a plane and rotating objects, and the length of a curve on a plane. Students are also taught various integration techniques and introduced to transcendental functions, numerical methods, and their approaches.

Code	Study Materials/Course Name	Description
SPHY1010	Measurement and Calibration	This course covers the concepts of measurement systems, sensor fundamentals, static and dynamic characteristics, measurement errors, calibration, and measurement uncertainty principles. Through this course, students will learn about measurement systems, including the types of components that make them up, the characteristics of each component, and techniques for obtaining accurate measurement results. Some of the measurement techniques studied are useful for reducing static errors, dynamic compensation techniques, techniques for addressing loading effects and noise, as well as calibration techniques. Physics graduates are expected to have a good understanding of physics instrumentation and be able to design measurement systems in physics.
SPHY1012	Practicum Measurement and Calibration	This course practicum aims to improve students' competence in performing measurement and calibration of physical measuring instruments, accompanied by measurement validation. Students are also introduced to standards and codes found in the industrial world. Graduates of the physics program are expected to be able to identify, operate, and perform routine maintenance on instrumentation systems using relevant and up-to-date methods, with a focus on monitoring, control, and safety activities in industrial production processes.
SPHY2001	Mathematical Physics I	This course is intended to provide students with an understanding of mathematical concepts related to series, complex numbers, matrices and determinants, partial differentials, multiple integrals, vector analysis, Fourier series and Fourier transforms, as well as their applications, and enable them to apply these concepts to physics problems.
SPHY2005	Modern Physics	The Modern Physics course provides knowledge and understanding of relativity theory, light duality, and quantum theory to prepare a framework for understanding atomic and nuclear physics. Next, atomic theory is developed with an emphasis on understanding quantum mechanics, followed by an understanding of atomic properties. Next, atomic nuclei and radioactivity will be discussed.

Code	Study Materials/Course Name	Description
SPHY2005	Thermodynamics	The Thermodynamics course teaches the basic concepts of thermodynamics, thermodynamic systems, and thermodynamic units. In general, the course material covers systems and environments, basic thermodynamic concepts, thermodynamic systems and units, the zeroth and first laws of thermodynamics, the concept of ideal gases, processes and cycles (Carnot engine, Stirling engine, and Otto engine), the Second Law of Thermodynamics (reversibility and irreversibility), work and heat transfer processes, entropy, and enthalpy.
SPHY2007	Practicum of Thermodynamics	The Practicum of Thermodynamics course provides students with a foundation in understanding the basic concepts of thermodynamics and its applications in technological advancements in the modern era. This Practicum of Thermodynamics course is a required course for students in the Physics Program at USK to complement the theoretical thermodynamics course. The topics covered in the laboratory component of this course include, among others: the zeroth law of Thermodynamics, analyzing and applying heat and the first law of Thermodynamics to various Thermodynamics systems, analyzing the properties of pure substances, and analyzing phase transformations.
SPHY2009	Electronics	This course covers the basic concepts of electronics, designed to provide physics students with an introductory understanding of electronics. Topics covered in this course include DC circuits, current sources, voltage sources, Thevenin equivalent circuits, Norton equivalent circuits, and AC circuits. Basic measurement tools: current meters, voltage meters, and resistance meters. Semiconductors, PN junctions, diodes, full-wave rectifiers, AC and DC load lines, transistors as small-signal amplifiers, field-effect transistors (FETs), IFETs, MOSFETs, transistor switches, multivibrators, astable circuits, monostable circuits. Filters: passive filters, amplitude response, phase response, Bode plot, low-pass filter, high-pass filter, inverting amplifier, non-inverting amplifier, summing amplifier, current amplifier, power amplifier, determining the efficiency of an amplifier, digital circuit theory: AND, OR, NOT, NAND, NOR, XOR.

Code	Study Materials/Course Name	Description
SPHY2011	Practicum of Electronics	This course discusses and practices the basics of analog electronics, characteristics of electronic components, rectifier circuits, transistor circuits as switches and amplifiers, operational amplifiers, and wave generator circuits.
SPHY2013	Algorithm and Programming	In addition to mastery of physics and its applications, mastery of research methodology and data analysis are also competencies required of physics graduates. The Algorithm and Programming course discusses how to solve physics problems using programming languages (Fortran, C++, Python, or Matlab). The topics covered include the basics of data structures and flowcharts, object-oriented programming, visualization, and graphics. In detail, these topics include the basics of input and output, data types and arithmetic operations, intrinsic functions, functions and subroutines, array processing, numerical methods, and several other interesting topics for applications in physics.
SPHY2015	Practicum of Algorithm and Programming	This course aims to help students develop their skills in designing, creating flowcharts and algorithms (coding), and running programs in the programming languages taught (Fortran, C++, or Matlab, etc.). Students are expected to be able to write and run programs for calculations, problem-solving, and simulations of physics problems, as well as present the results of calculations and simulations in graphical and visual formats.
SPHY2014	Mathematical Physics II	This course is intended to provide students with an understanding of mathematical concepts related to calculus of variations, tensor analysis, solutions to differential equations with series, special functions, partial differential equations, complex variable functions, and probability, and to enable them to apply these concepts to physics problems.

Code	Study Materials/Course Name	Description
SPHY2016	Waves	The Waves course teaches about the concepts of vibration and waves that occur in nature. The course material broadly covers: Simple harmonic motion (SHM): Damped SHM and forced oscillations, Coupled oscillations: Transverse waves; Longitudinal waves: Waves in transmission lines; Electromagnetic waves; Waves in higher dimensions: Numerical methods, Fourier methods; Waves in optical systems; Wave Mechanics; Wavelet Transformations.
SPHY2018	Practicum of Waves	The Practicum of Waves course is designed to introduce and train students in science practicums related to wave lecture material. In this practicum, students will study vibration measurements on springs, Melde experiments, string waves, and sound vibration resonance. The practical exercises are intended to strengthen students' understanding of physical phenomena related to vibration and wave phenomena. After completing this course, students are expected to master the basic knowledge of vibrations and waves through the Practicum of Waves and be able to develop and apply this knowledge to study more advanced physics concepts.
SPHY2020	Electromagnetics	In this course, students will learn about Coulomb's Law, static electric fields of point particles, electric fields, static charge distributions, charge density, sources of electric fields, electric potential, lines of force in static electric fields, Poisson's equation and Laplace's equation, electric dipoles, conductors and their electrical properties. Capacitors and capacitance, electrostatic properties of materials, electric current and current density, the continuity equation, fundamentals of static magnetic experiments, magnetic induction, motion of charged particles in a magnetic field, equations for stationary magnetic fields, vector potential, Faraday's law, magnetic dipoles, and the fields they generate, Magnetism of Materials, Permeability, Magnetization, Susceptibility, Maxwell's Equations, Electromagnetic Waves.

Code	Study Materials/Course Name	Description
SPHY2022	Practicum of Electromagnetics	In this course, students will learn about Coulomb's Law, static electric fields of point particles, electric fields, static charge distributions, charge density, sources of electric fields, electric potential, lines of force in static electric fields, Poisson's equation and Laplace's equation, electric dipoles, conductors and their electrical properties. Capacitors and capacitance, electrostatic properties of materials, electric current and current density, the continuity equation, fundamentals of static magnetic experiments, magnetic induction, motion of charged particles in a magnetic field, equations for stationary magnetic fields, vector potential, Faraday's law, magnetic dipoles, and the fields they generate, Magnetism of Materials, Permeability, Magnetization, Susceptibility, Maxwell's Equations, Electromagnetic Waves.
SPHY2024	Mechanics	Mechanics course, 1. Explains the mathematical description of mechanical interactions, including the motion of particles in one dimension (under the influence of constant forces, position-dependent forces, time, and velocity); harmonic oscillation (simple, damped, forced: resonance phenomena). Motion of particles in three dimensions (under the influence of conservative force fields), potential energy, conservation of mechanical energy and angular momentum; motion of particles under the influence of central force fields; Kepler's laws, Newton's law of gravity, planetary motion/trajectories. 2. Explain the mathematical description for the application of Mechanics in general coordinate systems, Hamilton's principle and Euler-Lagrange equations, Lagrange functions and energy functions, general momentum, Hamilton's equations, and phase space momentum. Analyzing and explaining Kepler's laws, conic section equations in polar coordinates, central forces and conservation of angular momentum, the postulates of special relativity, Lorentz transformations, phenomena of special relativity, as well as Euler's and Lagrange's descriptions, the concept of particles in fluids, streamlines, trajectories, and “streamlines,” the continuity equation for incompressible fluids.

Code	Study Materials/Course Name	Description
SPHY2026	Computational Physics	The Computational Physics course covers topics related to error analysis due to rounding and truncation in data storage and processing. Introduction to decimal, binary, and floating-point numbers. Solving 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: Runge-Kutta method, Finite difference equations: elliptic and parabolic equations, boundary value problems and eigenvalues, Numerical integration: box, trapezoid, Romberg, Newton-Cotes integrals (Simpson's, Simpson's 3/8th, Boole's), and Gaussian. Finite element method Fast Fourier Transform (FFT). Optimization: Golden Mean Search, Newton's Method, quadratic optimization, Gradient Descent, Random Brute-force Search
SPHY2028	Practicum of Computational Physics	Practicum of Computational Physics is a practicum that solves equations and special functions computationally, including derivatives, integrals, differential equations, characteristic functions, and matrices.
SPHY3001	Optics	Review of Wave Motion Mathematics, Electromagnetics Theory, Photons and Light, Electromagnetic Waves, Special Relativity, Covariant Formulation of Maxwell's Equations, Propagation of Light in Media and Between Media, Fermat's Principle, Effects of Anisotropic Media, Geometric Optics, Optical Instruments, Physical Optics, Wave Superposition, Polarization of Electromagnetic Waves, Interference, Diffraction, Fourier Optics, Basic Theory of Coherence, Modern Optics.
SPHY3003	Practicum of Optics	This course consists of practical activities to provide students with a deep understanding of the theories and concepts of optics discussed in lectures. This practical course includes a series of experiments designed to develop the practical skills, observation, and data analysis required in the context of physics in the field of optics.

Code	Study Materials/Course Name	Description
SPHY3005	Statistical Physics	Statistical physics can be viewed as a mathematical statistical problem given physical boundary conditions. The main topics covered include the derivation of the Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac distribution functions, along with the applications of these three types of statistical distribution functions, the concepts of phase space and state density in classical phase space and quantum phase space, the concept of entropy in the study of Statistical Physics, and an introduction to ensembles.
SPHY3007	Quantum Physics	This course covers the basic concepts of quantum physics, wave probability of matter, single particle wave function space, quantum physics dynamic equations (Schrödinger equation), applications of the Schrödinger equation to simple one-dimensional problems for both free particles and bound states, applications of the three-dimensional Schrödinger equation to hydrogen atoms (central force), orbital angular momentum, and angular momentum summation.
SPHY3030	Nuclear Physics	One of the competency requirements for physics graduates is the ability to understand physics concepts and their applications. The Nuclear Physics course is designed to provide an advanced understanding of the atomic nucleus, including the fundamental concepts of Nuclear Physics and its characteristics, fundamental nuclear forces, nuclear structure, radioactivity, the interaction of nuclear radiation with matter and methods for detecting it, alpha, beta, and gamma decay mechanisms, nuclear reactions and neutron physics, particle physics and its relationship to Nuclear Physics, Applications of Nuclear Physics in healthcare and as an energy source, elementary particles, and types of elementary particles. This course also provides foundational concepts in Nuclear Physics that will support related courses in subsequent semesters.
SPHY3032	Research Methodology	The Research Methodology course teaches scientific approaches to scientific development through scientific research. This course will begin with material on the perspective of Research Methodology. Next, the steps involved in conducting research will be explained. In this course, students will also be introduced to the steps involved in preparing proposals based on the FMIPA USK Final Project guidelines.

Code	Study Materials/Course Name	Description
SPHY3034	Solid State Physics	This lecture covers: Crystal Structure, Reciprocal Lattice, Crystal Bonds, Crystal Vibrations, Phonons, Free Electrons (Fermi Gas), Energy Bands (Electronic Properties), Semiconductors, Fermi Surface and Metals, Superconductivity, Dielectrics and Ferroelectrics, Diamagnetism and Paramagnetism, Ferromagnetism and Antiferromagnetism.
MKWUP001	Community Service Program	The Community Service Program (KKN) is a compulsory course that must be completed by USK students by participating directly in activities in a designated village for a period of one month or for a specified period of time. KKN is carried out in fields related to the application of physics, tailored to the interests of students and the problems faced by the target area. Students will be guided collectively by a designated supervisor. The results of the KKN activities are documented in the form of a KKN report.
SMPAP002	Research Proposal	Research Proposal is a course that integrates cognitive, affective, and psychomotor skills, written in the form of a Research Proposal and to be carried out in the Final Project course in accordance with the field of study pursued. The main activity in the Research Proposal is a research plan written in accordance with the Final Project and Internship guidebook, FMIPA, USK, which is then presented in front of students and the examination team.
SMPAP001	Internship (KKP)	Internship (KKP) is a form of academic implementation carried out directly at an institution or company. Through internship activities, students gain experience, hone their skills and abilities in the workplace, and apply the knowledge they have acquired during their studies. This course is not a traditional classroom-based course but rather a field study and visit to an institution/company chosen by the students, thereby giving them an understanding of how physics is applied in related fields.

Code	Study Materials/Course Name	Description
SPHY4075	Scientific Writing	One of the competency requirements for graduates in taking the Scientific Writing course is the ability to understand the concepts of writing a scientific paper. The Scientific Writing course is designed to provide an understanding of how to create scientific works such as journals, final project reports (theses), and papers that are well-written and adhere to EYD guidelines. This course also provides a basic understanding of Scientific Writing and how to analyze a scientific work (journal), which will support related courses in the following semester.
SMPAPA01	Final Project	The Final Project is a required course that must be completed by a Physics Program student by integrating the cognitive, psychomotor, and affective competencies learned through research activities in their field of study. The Final Project is a requirement for obtaining a Bachelor of Science degree from the Faculty of Mathematics and Natural Sciences at USK. The preparation, activities, and results of the Final Project research are documented in a report and presented before an examination committee. The Final Project research may be conducted in laboratories at USK or at other government or private institutions/organizations. The research findings are presented at peer-reviewed seminars or within academic disciplines and also presented during a comprehensive examination before the examination committee.

3.6 Curriculum Structure

Table 3.8. List of Courses

No	Code	Course Name	SKS	(T-P)	Category	Prerequisites
Semester I						
1	MKWU1002	Civic Education	2	T	W	-
2	MKWU1005	Disaster Management and Environment	2	T	W	-
3	MKWU1006	Character Building 1	0	-	W	-
4	SMPA 1001	Introduction to Calculus	3	T	W	-
5	SMPA 1003	Introduction to Physics	2	T	W	-
6	SPHY1001	Practicum of Introduction to Physics	1	P	W	-
7	SMPA 1005	Introduction to Chemistry	2	T	W	-

No	Code	Course Name	SKS	(T-P)	Category	Prerequisites
8	SMKM1001	Practicum of Introduction to Chemistry	1	P	W	-
9	SMPA 1007	Introduction to Biology	2	T	W	-
10	SMBI1001	Practicum of Introduction to Biology	1	P	W	-
11	SMPA P001	Statistical Methods	2	T	W	-
12	SMPA1009	Introduction to Industrial Revolution	2	T	W	-
Total			**20**			
Semester II						
1	MKWU1003	Indonesian Language	2	T	W	-
2	MKWU1001	Pancasila	2	T	W	-
3	MKWU1004	English	2	T	W	-
4	MKWU1007	Character Building II	0	-	W	-
5	SPHY 1002	Occupational Health and Safety	2	T	W	-
6	SPHY 1004	Fundamental of Physics	4	T	W	-
7	SPHY1006	Practicum of Fundamental of Physics	1	P	W	-
8	SPHY1008	Calculus of Physics	4	T	W	-
9	SPHY1010	Measurement and Calibration	2	T	W	-
10	SPHY1012	Practicum Measurement and Calibration	1	P	W	-
Total			**20**			
Semester III						
1	MKWU2001	Religion Education	2	T	W	Passed UP3AI
2	SPHY 2003	Mathematical Physics 1	4	T	W	SMPA 1001
3	SPHY 2005	Modern Physics	3	T	W	SPHY 1004
4	SPHY 2007	Thermodynamics	3	T	W	-
5	SPHY2009	Practicum of Thermodynamics	1	P	W	-
6	SPHY 2011	Electronics	3	T	W	-
7	SPHY2013	Practicum of Electronics	1	P	W	-
8	SPHY 2015	Algorithm and Programming	2	T	W	-
9	SPHY2017	Practicum of Algorithm and Programming	1	P	W	-
Total			**20**			
Semester IV						
1	SPHY2014	Mathematical Physics II	4	T	W	SPHY 2001
2	SPHY2016	Waves	3	T	W	SPHY 1004
3	SPHY2018	Practicum of Waves	1	P	W	-
4	SPHY2020	Electromagnetics	3	T	W	SPHY 1004
5	SPHY2022	Practicum of Electromagnetics	1	P	W	-
6	SPHY2024	Mechanics	4	T	W	SPHY 1004
7	SPHY2026	Computational Physics	3	T	W	SPHY 1004

No	Code	Course Name	SKS	(T-P)	Category	Prerequisites
8	SPHY2028	Practicum of Computational Physics	1	P	W	-
Total			**20**			
Semester V						
1	SMPA3013	Entrepreneurship	2	T	W	-
2	SMPA3015	Practicum Entrepreneurship	1	P	W	-
3	SPHY3017	Optics	3	T	W	-
4	SPHY3019	Practicum of Optics	1	P	W	-
5	SPHY3021	Statistical Physics	3	T	W	-
6	SPHY3023	Quantum Physics	4	T	W	-
7		Elective courses	6	T	P	-
Total			**20**			
Semester VI						
1	SPHY3030	Nuclear Physics	3	T	W	-
2	SPHY3032	Research Methodology	2	T	W	-
3	SPHY3034	Solid State Physics	4	T	W	-
4		Elective courses	10	T	P	-
Total			**19**			
Semester VII						
1	MKWUP001	Community Service Program	2	P	W	In accordance with P3KKN regulations
2	SMPAP002	Research Proposal	2	P	W	Graduated with ≥120 SKS credits, GPA ≥ 2.0, D grade ≤10% of credits achieved.
3	SMPAP001	Internship	3	T	W	In accordance with the guidelines
4	SPHY 4075	Scientific Writing	2	T	W	-
5		Elective courses	12	T	W	-
Total			**21**			
Semester VIII						
1	SMPAPA01	Final Project	4	P	W	Passed or currently taking SMPAP007
Total			**4**			
Total of SKS			**144**			
List of Elective Courses for the Semester						
Semester V						
1	SPHY6025	Geographic Information System	2	T	P	-
2	SPHY6027	Practicum of Geographic Information System	1	P	P	-
3	SPHY6029	Electromagnetic Methods	2	T	P	-
4	SPHY6031	Vulcanology and Geothermal	2	T	P	-

No	Code	Course Name	SKS	(T-P)	Category	Prerequisites
5	SPHY6033	Physical Geology	2	T	P	-
6	SPHY6035	*Biomaterial*	2	T	P	-
7	SPHY6037	Material Science	3	T	P	-
8	SPHY6039	Semiconductor	2	T	P	-
9	SPHY6041	Composite Physics	2	T	P	-
10	SPHY6043	Geometrical Optics	2	T	P	-
11	SPHY6045	Physical Optics	2	T	P	-
12	SPHY6047	Acoustics	2	T	P	-
13	SPHY6049	Photonics	2	T	P	-
14	SPHY6051	Light and Color	2	T	P	-
15	SPHY6053	Particle Physics	2	T	P	-
16	SPHY6055	Introduction to Radiological Physics	2	T	P	-
17	SPHY6057	Practicum Introduction to Radiological Physics	1	P	P	-
18	SPHY6059	Anatomy and Physiology	2	T	P	-
19	SPHY6061	Reactor Physics	2	T	P	-
20	SPHY6063	Dosimetry and Radiation Protection	2	T	P	-
21	SPHY6065	Biophysics	2	T	P	-
22	SMPAP003	Entrepreneurial Practice	17	P	P	-
23	SMPAP005	Industrial Internship A	17	P	P	-
24	SPHY6067	Electronics and Instrumentation Design	2	T	P	-
25	SPHY6069	Practicum of Electronics and Instrumentation Design	1	P	P	-
26	SPHY6071	Sensors and Transducers	2	T	P	-
27	SPHY6073	Practicum of Sensors and Transducers	1	P	P	-
Semester VI						
1	SMPAP004	Scientific Publication	11	P	P	-
2	SMPAP006	Industrial Internship B	11	P	P	-
3	SPHY6036	Introduction to Geophysics	2	T	P	-
4	SPHY6038	Potential Field Survey	2	T	P	-
5	SPHY6040	Seismic Methods	2	T	P	-
6	SPHY6042	Geotechnics	2	T	P	-
7	SPHY6044	Mineral and Rock Physics	2	T	P	-
8	SPHY6046	Remote Sensing	2	T	P	-

No	Code	Course Name	SKS	(T-P)	Category	Prerequisites
9	SPHY6048	Practicum of Remote Sensing	1	P	P	-
10	SPHY6050	Special Topic of Geophysics	2	T	P	-
11	SPHY6052	Renewable Energy	2	T	P	-
12	SPHY6054	Material Characterization	2	T	P	-
13	SPHY6056	Practicum of Material Characterization	2	P	P	-
14	SPHY6058	Ceramic Physics	2	T	p	-
15	SPHY6060	Solar Cells	2	T	P	-
16	SPHY6062	Introduction to Optoelectronics	2	T	P	-
17	SPHY6064	Instrument Optics	2	T	P	-
18	SPHY6066	Laser and Spectroscopy Experiments	2	P	P	-
19	SPHY6068	Optical Communications	2	T	P	-
20	SPHY6070	Basics Optometry	2	T	P	-
21	SPHY6072	Introduction to Radiotherapy	2	T	P	-
22	SPHY6074	Radiobiology	2	T	P	-
23	SPHY6076	Introduction to Nuclear Medicine	2	T	P	-
24	SPHY6078	Physics of Medical Imaging	2	T	P	-
25	SPHY6080	Server and Computer Network System	2	T	P	-
26	SPHY6082	Practicum of Server and Computer Network System	1	P	P	-
27	SPHY6084	Embedded Electronic System	2	T	P	-
28	SPHY6086	Practicum of Embedded Electronic System	1	P	P	-
29	SPHY6088	Medical Instrumentation	2	T	P	-
30	SPHY6090	Practicum of Medical Instrumentation	1	P	P	-
Semester VII						
1	SPHY6077	Meteorology and Weather Modeling	2	T	P	-
2	SPHY6079	Data Analysis and Geophysics Modeling	2	T	P	-
3	SPHY6081	Seismology	2	T	P	-
4	SPHY6083	Field Geophysics	2	T	P	-

No	Code	Course Name	SKS	(T-P)	Category	Prerequisites
5	SPHY6085	Geophysics and Meteorology Instrumentation	2	T	P	-
6	SPHY6087	Nano Materials	2	T	P	-
7	SPHY6089	Magnetic Materials	2	T	P	-
8	SPHY6091	Corrosion	2	T	P	-
9	SPHY6093	Laser	2	T	P	-
10	SPHY6095	Optical Instrumentation	2	T	P	-
11	SPHY6097	Spectroscopy	2	T	P	-
12	SPHY6099	Radiometry	2	P	P	-
13	SPHY6101	Photometry	2	T	P	-
14	SPHY6103	Theoretical Physics Methods	2	T	P	-
15	SPHY6105	Artificial Intelligence	2	T	P	-
16	SPHY6107	Analytical Mechanics	2	T	P	-
17	SPHY6109	Radiotherapy Planning	2	T	P	-
18	SPHY6111	Introduction to Biomedical Engineering	2	T	P	-
19	SPHY6113	Astronomy	2	T	P	-
20	SMPAP007	Village Project A	18	P	P	-
21	SMPAP009	Science Teaching Practice A	18	P	P	-
22	SPHY6115	Internet of Things (IoT)	2	T	P	-
23	SPHY6117	Practicum of Internet of Things (IoT)	1	P	P	-
24	SPHY6119	Data Communication and Telemetry	2	T	P	-
25	SPHY6121	Practicum of Data Communication and Telemetry	1	P	P	-
26	SPHY6123	Control System and Mechatronics	2	T	P	-
27	SPHY6125	Practicum of Control System and Mechatronics	1	P	P	-
Semester VIII						
1	SMPAP008	Village Project B	12	P	P	-
2	SMPAP010	Science Teaching Practice B	12	P	P	-
3	SPHY6092	Photography and Videography Optics	2	T	P	-
4	SPHY6094	Laser Semiconductor	2	T	P	-
5	SPHY6096	Numerical Methods	2	T	P	-
6	SPHY6098	Electrodynamics	2	T	P	-
7	SPHY6100	Relativity Physics	2	T	P	-
8	SPHY6102	Bioelectronics	2	T	P	-

No	Code	Course Name	SKS	(T-P)	Category	Prerequisites
9	SPHY6104	Signal Processing	2	T	P	-
10	SPHY6106	Practicum of Signal Processing	1	P	P	-

3.7 Summary

Table 3.9. General Information on Study Materials

General Information	Total SKS
Minimum amount of credit load to be passed	144
Number of elective courses to be taken	28
Number of elective courses offered	94
Number of common compulsory course components (MKWU)	12
Number of skill course components	37
Number of basic disciplinary course components	20
Number of disciplinary/skill course components	60
Number of curricular/extracurricular activities that encourage innovation, entrepreneurship and IT skills	7
Course components that align with the vision of the SDGs	114

Table 3.10. Characteristics of Elective Courses

No	Code	Course	SKS	Characteristics						
				A	B	C	D	E	F	G
Semester I										
1	MKWU1002	Civic Education	2							√
2	MKWU1005	Disaster Management and Environment	2							√
3	MKWU1006	Character Building 1	0							
4	SMPA1001	Introduction to Calculus	3	√						
5	SMPA1003	Introduction to Physics	2	√						
6	SPHY1001	Practicum of Introduction to Physics	1	√						
7	SMPA1005	Introduction to Chemistry	2	√						
8	SMKM1001	Practicum of Introduction to Chemistry	1	√						
9	SMPA1007	Introduction to Biology	2	√						
10	SMBI1001	Practicum of Introduction to Biology	1	√						
11	SMPAP001	Statistical Methods	2	√						

12	SMPA1009	Introduction to Industrial Revolution	2			√				
Total			**20**							
Semester II										
1	MKWU1003	Indonesian Language	2	√						
2	MKWU1001	Pancasila	2							√
3	MKWU1004	English	2					√		
4	MKWU1007	Character Building II	0							√
5	SPHY1002	Occupational Health and Safety	2		√					
6	SPHY1004	Fundamental of Physics	4	√						
7	SPHY1006	Practicum of Fundamental of Physics	1	√	√					
8	SPHY1008	Calculus of Physics	4	√						
9	SPHY1010	Measurement and Calibration	2		√					
10	SPHY1012	Practicum Measurement and Calibration	1		√					
Total			**20**							
Semester III										
1	MKWU2001	Religion Education	2	√						
2	SPHY2003	Mathematical Physics 1	4	√						
3	SPHY2005	Modern Physics	3	√						
4	SPHY2007	Thermodynamics	3	√						
5	SPHY2009	Practicum of Thermodynamics	1	√						
6	SPHY2011	Electronics	3		√					
7	SPHY2013	Practicum of Electronics	1		√					
8	SPHY2015	Algorithm and Programming	2			√				
9	SPHY2017	Practicum of Algorithm and Programming	1			√				
Total			**20**							
Semester IV										
1	SPHY2014	Mathematical Physics II	4	√						
2	SPHY2016	Waves	3	√						
3	SPHY2018	Practicum of Waves	1	√						
4	SPHY2020	Electromagnetics	3	√						
5	SPHY2022	Practicum of Electromagnetics	1	√						
6	SPHY2024	Mechanics	4	√						
7	SPHY2026	Computational Physics	3			√				
8	SPHY2028	Practicum of Computational Physics	1			√				
Total			**20**							
Semester V										

1	SMPA3013	Entrepreneurship	2				√			
2	SMPA3015	Practicum Entrepreneurship	1				√			
3	SPHY3017	Optics	3	√						
4	SPHY3019	Practicum of Optics	1		√					
5	SPHY3021	Statistical Physics	3	√						
6	SPHY3023	Quantum Physics	4	√						
7		Elective courses	6							
Total			**20**							
Semester VI										
1	SPHY3030	Nuclear Physics	3	√						
2	SPHY3032	Research Methodology	2		√					
3	SPHY3034	Solid State Physics	4	√						
4		Elective courses	10							
Total			**19**							
Semester VII										
1	MKWUP001	Community Service Program	2						√	
2	SMPAP002	Research Proposal	2					√		
3	SMPAP001	Internship	3					√	√	
4	SPHY 4075	Scientific Writing	2		√					
5		Elective courses	12							
Total			**21**							
Semester VIII										
1	SMPAPA01	Final Project	4	√						
Total			**4**							
Total SKS			**144**							
List of Elective Courses for the Semester										
Semester V										
1	SPHY6025	Geographic Information System	2		√	√				
2	SPHY6027	Practicum of Geographic Information System	1		√	√				
3	SPHY6029	Electromagnetic Methods	2	√						
4	SPHY6031	Vulcanology and Geothermal	2		√					
5	SPHY6033	Physical Geology	2		√					
6	SPHY6035	*Biomaterial*	2		√					
7	SPHY6037	Material Science	3	√						
8	SPHY6039	Semiconductor	2	√						
9	SPHY6041	Composite Physics	2	√						
10	SPHY6043	Geometrical Optics	2	√						
11	SPHY6045	Physical Optics	2	√						
12	SPHY6047	Acoustics	2	√						
13	SPHY6049	Photonics	2	√						
14	SPHY6051	Light and Color	2		√					
15	SPHY6053	Particle Physics	2	√						

16	SPHY6055	Introduction to Radiological Physics	2	√						
17	SPHY6057	Practicum Introduction to Radiological Physics	1		√					
18	SPHY6059	Anatomy and Physiology	2	√						
19	SPHY6061	Reactor Physics	2	√						
20	SPHY6063	Dosimetry and Radiation Protection	2		√					
21	SPHY6065	Biophysics	2	√						
22	SMPAP003	Entrepreneurial Practice	17				√		√	
23	SMPAP005	Industrial Internship A	17		√				√	
24	SPHY6067	Electronics and Instrumentation Design	2		√					
25	SPHY6069	Practicum of Electronics and Instrumentation Design	1		√					
26	SPHY6071	Sensors and Transducers	2	√						
27	SPHY6073	Practicum of Sensors and Transducers	1		√					
Semester VI										
1	SMPAP004	Scientific Publication	11		√					
2	SMPAP006	Industrial Internship B	11		√				√	
3	SPHY6036	Introduction to Geophysics	2	√						
4	SPHY6038	Potential Field Survey	2	√						
5	SPHY6040	Seismic Methods	2	√						
6	SPHY6042	Geotechnics	2	√						
7	SPHY6044	Mineral and Rock Physics	2	√						
8	SPHY6046	Remote Sensing	2		√					
9	SPHY6048	Practicum of Remote Sensing	1		√					
10	SPHY6050	Special Topic of Geophysics	2	√						
11	SPHY6052	Renewable Energy	2	√						
12	SPHY6054	Material Characterization	2	√						
13	SPHY6056	Practicum of Material Characterization	2		√					
14	SPHY6058	Ceramic Physics	2	√						
15	SPHY6060	Solar Cells	2	√						
16	SPHY6062	Introduction to Optoelectronics	2	√						
17	SPHY6064	Instrument Optics	2	√						
18	SPHY6066	Laser and Spectroscopy Experiments	2	√						

19	SPHY6068	Optical Communications	2	√						
20	SPHY6070	Basics Optometry	2	√						
21	SPHY6072	Introduction to Radiotherapy	2	√						
22	SPHY6074	Radiobiology	2	√						
23	SPHY6076	Introduction to Nuclear Medicine	2		√					
24	SPHY6078	Physics of Medical Imaging	2		√					
25	SPHY6080	Server and Computer Network System	2			√				
26	SPHY6082	Practicum of Server and Computer Network System	1			√				
27	SPHY6084	Embedded Electronic System	2			√				
28	SPHY6086	Practicum of Embedded Electronic System	1			√				
29	SPHY6088	Medical Instrumentation	2		√					
30	SPHY6090	Practicum of Medical Instrumentation	1		√					
Semester VII										
1	SPHY6077	Meteorology and Weather Modeling	2		√					
2	SPHY6079	Data Analysis and Geophysics Modeling	2		√					
3	SPHY6081	Seismology	2		√					
4	SPHY6083	Field Geophysics	2	√						
5	SPHY6085	Geophysics and Meteorology Instrumentation	2		√					
6	SPHY6087	Nano Materials	2	√						
7	SPHY6089	Magnetic Materials	2	√						
8	SPHY6091	Corrosion	2	√						
9	SPHY6093	Laser	2	√						
10	SPHY6095	Optical Instrumentation	2		√					
11	SPHY6097	Spectroscopy	2	√						
12	SPHY6099	Radiometry	2	√						
13	SPHY6101	Photometry	2	√						
14	SPHY6103	Theoretical Physics Methods	2	√						
15	SPHY6105	Artificial Intelligence	2			√				
16	SPHY6107	Analytical Mechanics	2	√						
17	SPHY6109	Radiotherapy Planning	2		√					
18	SPHY6111	Introduction to Biomedical Engineering	2		√					
19	SPHY6113	Astronomy	2	√						

20	SMPAP007	Village Project A	18						√	
21	SMPAP009	Science Teaching Practice A	18						√	
22	SPHY6115	Internet of Things (IoT)	2			√				
23	SPHY6117	Practicum of Internet of Things (IoT)	1			√				
24	SPHY6119	Data Communication and Telemetry	2			√				
25	SPHY6121	Practicum of Data Communication and Telemetry	1			√				
26	SPHY6123	Control System and Mechatronics	2		√					
27	SPHY6125	Practicum of Control System and Mechatronics	1		√					
Semester VIII										
1	SMPAP008	Village Project B	12						√	
2	SMPAP010	Science Teaching Practice B	12						√	
3	SPHY6092	Photography and Videography Optics	2	√						
4	SPHY6094	Laser Semiconductor	2	√						
5	SPHY6096	Numerical Methods	2			√				
6	SPHY6098	Electrodynamics	2	√						
7	SPHY6100	Relativity Physics	2	√						
8	SPHY6102	Bioelectronics	2		√					
9	SPHY6104	Signal Processing	2	√						
10	SPHY6106	Practicum of Signal Processing	1		√					

Remarks:
A = Deepening the field of knowledge
B = Enhancing skills/professionalism in the world of practice
C = Improving IT skills
D = Promoting entrepreneurship
E = Enhancing soft skills
F = Can be equivalent to MBKM activities
G = Others
T = Tutorial
P = Practicum

Table 3.11 List of courses related to SDGs, PBR, PjBL, Case-M and/or MBKM

No	Code	Course Name	SKS	Category	Target SDGs	Remarks			
						PBR	PjBL	Case-M	MBKM
1	MKWU1002	Civic Education	2						
2	MKWU1005	Disaster Management and Environment	2						
3	MKWU1006	Character Building 1							

4	SMPA1001	Introduction to Calculus	3						
5	SMPA1003	Introduction to Physics	2		4				
6	SPHY1001	Practicum of Introduction to Physics	1		4				
7	SMPA1005	Introduction to Chemistry	2						
8	SMKM1001	Practicum of Introduction to Chemistry	1						
9	SMPA1007	Introduction to Biology	2						
10	SMBI1001	Practicum of Introduction to Biology	1						
11	SMPAP001	Statistical Methods	2						
12	SMPA1009	Introduction to Industrial Revolution	2		7				
13	MKWU1003	Indonesian Language	2						
14	MKWU1001	Pancasila	2						
15	MKWU1004	English	2						
16	MKWU1007	Character Building II	0						
17	SPHY1002	Occupational Health and Safety	2						
18	SPHY1004	Fundamental of Physics	4		4				
19	SPHY1006	Practicum of Fundamental of Physics	1		4				
20	SPHY1008	Calculus of Physics	4						
21	SPHY1010	Measurement and Calibration	2		8; 9			√	
22	SPHY1012	Practicum Measurement and Calibration	1		8; 9		√		
23	MKWU2001	Religion Education	2						
24	SPHY2003	Mathematical Physics 1	4						
25	SPHY2005	Modern Physics	3						
26	SPHY2007	Thermodynamics	3					√	
27	SPHY2009	Practicum of Thermodynamics	1				√		
28	SPHY2011	Electronics	3		8; 9				
29	SPHY2013	Practicum of Electronics	1		8; 9		√		
30	SPHY2015	Algorithm and Programming	2		8; 9			√	
31	SPHY2017	Practicum of Algorithm and Programming	1		8; 9		√		
32	SPHY2014	Mathematical Physics II	4						
33	SPHY2016	Waves	3						
34	SPHY2018	Practicum of Waves	1						
35	SPHY2020	Electromagnetics	3						
36	SPHY2022	Practicum of Electromagnetics	1						
37	SPHY2024	Mechanics	4						
38	SPHY2026	Computational Physics	3		8; 9			√	

39	SPHY2028	Practicum of Computational Physics	1		8; 9		√		
40	SMPA3013	Entrepreneurship	2						
41	SMPA3015	Practicum Entrepreneurship	1						
42	SPHY3017	Optics	3						
43	SPHY3019	Practicum of Optics	1						
44	SPHY3021	Statistical Physics	3						
45	SPHY3023	Quantum Physics	4						
46	SPHY3030	Nuclear Physics	3		9;11				
47	SPHY3032	Research Methodology	2						
48	SPHY3034	Solid State Physics	4						
49	MKWUP001	Community Service Program	2						√
50	SMPAP002	Research Proposal	2						
51	SMPAP001	Internship	3						√
52	SPHY 4075	Scientific Writing	2						
53	SMPAPA01	Final Project	4						
54	SPHY6025	Geographic Information System	2		8; 9			√	
55	SPHY6027	Practicum of Geographic Information System	1		8; 9		√		
56	SPHY6029	Electromagnetic Methods	2						
57	SPHY6031	Vulcanology and Geothermal	2						
58	SPHY6033	Physical Geology	2					√	
59	SPHY6035	*Biomaterial*	2		8				
60	SPHY6037	Material Science	3					√	
61	SPHY6039	Semiconductor	2		8			√	
62	SPHY6041	Composite Physics	2					√	
63	SPHY6043	Geometrical Optics	2						
64	SPHY6045	Physical Optics	2						
65	SPHY6047	Acoustics	2					√	
66	SPHY6049	Photonics	2						
67	SPHY6051	Light and Color	2		8			√	
68	SPHY6053	Particle Physics	2						
69	SPHY6055	Introduction to Radiological Physics	2		3				
70	SPHY6057	Practicum Introduction to Radiological Physics	1		3		√		
71	SPHY6059	Anatomy and Physiology	2				√		
72	SPHY6061	Reactor Physics	2		7; 8; 9		√		
73	SPHY6063	Dosimetry and Radiation Protection	2		3			√	
74	SPHY6065	Biophysics	2						
75	SMPAP003	Entrepreneurial Practice	17						√
76	SMPAP005	Industrial Internship A	17						√

77	SPHY6067	Electronics and Instrumentation Design	2		8; 9			√	
78	SPHY6069	Practicum of Electronics and Instrumentation Design	1		8; 9		√		
79	SPHY6071	Sensors and Transducers	2		8; 9			√	
80	SPHY6073	Practicum of Sensors and Transducers	1		8; 9		√		
81	SMPAP004	Scientific Publication	11						√
82	SMPAP006	Industrial Internship B	11						√
83	SPHY6036	Introduction to Geophysics	2		8			√	
84	SPHY6038	Potential Field Survey	2		8			√	
85	SPHY6040	Seismic Methods	2		8				
86	SPHY6042	Geotechnics	2						
87	SPHY6044	Mineral and Rock Physics	2		4			√	
88	SPHY6046	Remote Sensing	2		8; 9			√	
89	SPHY6048	Practicum of Remote Sensing	1		8; 9		√		
90	SPHY6050	Special Topic of Geophysics	2		8			√	
91	SPHY6052	Renewable Energy	2		7;11			√	
92	SPHY6054	Material Characterization	2		8			√	
93	SPHY6056	Practicum of Material Characterization	2		8		√		
94	SPHY6058	Ceramic Physics	2		8			√	
95	SPHY6060	Solar Cells	2		7;11			√	
96	SPHY6062	Introduction to Optoelectronics	2		7;11			√	
97	SPHY6064	Instrument Optics	2						
98	SPHY6066	Laser and Spectroscopy Experiments	2					√	
99	SPHY6068	Optical Communications	2					√	
100	SPHY6070	Basics Optometry	2					√	
101	SPHY6072	Introduction to Radiotherapy	2		3;11				
102	SPHY6074	Radiobiology	2		3;11				
103	SPHY6076	Introduction to Nuclear Medicine	2		3;11				
104	SPHY6078	Physics of Medical Imaging	2		3;11			√	
105	SPHY6080	Server and Computer Network System	2		11			√	
106	SPHY6082	Practicum of Server and Computer Network System	1		11		√		
107	SPHY6084	Embedded Electronic System	2		11			√	
108	SPHY6086	Practicum of Embedded Electronic System	1		11		√		

109	SPHY6088	Medical Instrumentation	2		3;11				
110	SPHY6090	Practicum of Medical Instrumentation	1		3;11			√	
111	SPHY6077	Meteorology and Weather Modeling	2		13		√		
112	SPHY6079	Data Analysis and Geophysics Modeling	2		6				
113	SPHY6081	Seismology	2		11			√	
114	SPHY6083	Field Geophysics	2		6				
115	SPHY6085	Geophysics and Meteorology Instrumentation	2		6;13			√	
116	SPHY6087	Nano Materials	2		9				
117	SPHY6089	Magnetic Materials	2		9				
118	SPHY6091	Corrosion	2						
119	SPHY6093	Laser	2		9				
120	SPHY6095	Optical Instrumentation	2		8; 9			√	
121	SPHY6097	Spectroscopy	2		9				
122	SPHY6099	Radiometry	2		9			√	
123	SPHY6101	Photometry	2		9				
124	SPHY6103	Theoretical Physics Methods	2						
125	SPHY6105	Artificial Intelligence	2		9;11			√	
126	SPHY6107	Analytical Mechanics	2						
127	SPHY6109	Radiotherapy Planning	2						
128	SPHY6111	Introduction to Biomedical Engineering	2						
129	SPHY6113	Astronomy	2						
130	SMPAP007	Village Project A	18						√
131	SMPAP009	Science Teaching Practice A	18						√
132	SPHY6115	Internet of Things (IoT)	2		9;11			√	
133	SPHY6117	Practicum of Internet of Things (IoT)	1		9;11		√		
134	SPHY6119	Data Communication and Telemetry	2		11			√	
135	SPHY6121	Practicum of Data Communication and Telemetry	1		11		√		
136	SPHY6123	Control System and Mechatronics	2					√	
137	SPHY6125	Practicum of Control System and Mechatronics	1		9		√		
138	SMPAP008	Village Project B	12						√
139	SMPAP010	Science Teaching Practice B	12						√
140	SPHY6092	Photography and Videography Optics	2					√	
141	SPHY6094	Laser laserSemiconductor	2		11			√	
142	SPHY6096	Numerical Methods	2						

143	SPHY6098	Electrodynamics	2						
144	SPHY6100	Relativity Physics	2						
145	SPHY6102	Bioelectronics	2		3				
146	SPHY6104	Signal Processing	2					√	
147	SPHY6106	Practicum of Signal Processing	1				√		

SDGs = Sustainable Development Goals (SDGs) are a universal agenda agreement until 2030 for sustainable development based on human rights and equality. SDGs consist of 17 goals and 169 targets. (1) No poverty; (2) No hunger; (3) Good health and well-being; (4) Quality education; (5) Gender equality; (6) Clean water and sanitation; (7) Affordable and clean energy; (8) Decent work and economic growth; (9) Industry, innovation, and infrastructure; (10) Reduced inequalities; (11) Sustainable cities and communities; (12) Responsible consumption and production; (13) Climate action; (14) Life below water; (15) Life on land; (16) Peace, justice, and strong institutions; (17) Partnerships for the goals (Bappenas 2017).

PBR = Research-Based Learning
PjBL = Project-Based Learning
Case-M = Case Method
MBKM = Independent Learning, Independent Campus

3.8 List of Equivalencies and Recognition of MBKM Program Activities towards Credit Recognition

3.8.1 List of Course Equivalencies

Table 3.12. List of Course Equivalencies

Former Courses				New Course			
No	**Course Code**	**Course Name**	**SKS**	**No**	**Course Code**	**Course Name**	**SKS**
1	MKS103	Pancasila and Civic Education	2	1	MKWU1002	Civic Education	2
2	MKS106	Disaster Management and Environment Knowledge	2	2	MKWU1005	Disaster Management and Environment	2
3	MKS107	Character Building I	0	3	MKWU1006	Character Building 1	0
4	MPA 101	Introduction to Calculus	3	4	SMPA1001	Introduction to Calculus	3
5	MPA103	Introduction to Physics	3	5	SMPA1003	Introduction to Physics	2
				6	SPHY1001	Practicum of Introduction to Physics	1
6	MPA 105	Introduction to Chemistry	3	7	SMPA1005	Introduction to Chemistry	2
				8	SMKM1001	Practicum of Introduction to Chemistry	1
7	MPA 107	Introduction to Biology	3	9	SMPA1007	Introduction to Biology	2

				10	SMBI1001	Practicum of Introduction to Biology	1
8	MPA P02	Introduction to Statistics	3	11	SMPA1011	Statistical Methods	2
9	MPA P01	Introduction to ICT		12	SMPA1009	Introduction to Industrial Revolution	2
10	MKS101	Indonesian Language	2	13	MKWU1003	Indonesian Language	2
11	MKS104	Basic Social and Cultural Science	2	14	MKWU1001	Pancasila	2
12	MKS 201	English	2	15	MKWU1004	English	2
13	MKS 202	Character Building II	0	16	MKWU1007	Character Building II	0
				17	SPHY1002	Occupational Health and Safety	2
14	PHY 104	Fundamental of Physics	5	18	SPHY1004	Fundamental of Physics	4
				19	SPHY1006	Practicum of Fundamental of Physics	1
15	PHY 106	Calculus of Physics	4	20	SPHY1008	Calculus of Physics	4
16	PHY 108	Measurement and Measuring Instruments	2	21	SPHY1010	Measurement and Calibration	2
				22	SPHY1012	Practicum Measurement and Calibration	1
17	MKS105	Religion		23	MKWU2001	Religion Education	2
18	PHY 201	Mathematical Physics I	4	24	SPHY2003	Mathematical Physics 1	4
19	PHY 203	Modern Physics	4	25	SPHY2005	Modern Physics	3
20	PHY 205	Thermodynamics	4	26	SPHY2007	Thermodynamics	3
				27	SPHY2009	Practicum of Thermodynamics	1
21	PHY 207	Electronics	4	28	SPHY2011	Electronics	3
				29	SPHY2013	Practicum of Electronics	1
22	PHY 301	Algorithm and Programming	3	30	SPHY2015	Algorithm and Programming	2
				31	SPHY2017	Practicum of Algorithm and Programming	1
23	PHY 202	Mathematical Physics II	4	32	SPHY2014	Mathematical Physics II	4
24	PHY 204	Waves	2	33	SPHY2016	Waves	3
25	PHY 210	Eksperimen Fisika II	2	34	SPHY2018	Practicum of Waves	1
26	PHY 206	Electromagnetics	4	35	SPHY2020	Electromagnetics	3
27	PHY 210	Eksperimen Fisika II	2	36	SPHY2022	Practicum of Electromagnetics	1
28	PHY 208	Mechanics	4	37	SPHY2024	Mechanics	4
29	PHY 304	Computational Physics	3	38	SPHY2026	Computational Physics	3
				39	SPHY2028	Practicum of Computational Physics	1
30	MPA P03	Entrepreneurship	2	40	SMPA3013	Entrepreneurship	2
				41	SMPA3015	Practicum Entrepreneurship	1
31	PHY 303	Optics	2	42	SPHY3017	Optics	3
32	PHY 309	Physics Experiment III	1	43	SPHY3019	Practicum of Optics	1
33	PHY 305	Statistical Physics	3	44	SPHY3021	Statistical Physics	3
34	PHY 307	Quantum Physics	4	45	SPHY3023	Quantum Physics	4
35	PHY 302	Nuclear Physics	3	46	SPHY3030	Nuclear Physics	3
36	PHY 401	Research Methodology	2	47	SPHY3032	Research Methodology	2
37	PHY 306	Solid State Physics	4	48	SPHY3034	Solid State Physics	4
38	MKS P02	Community Service Program	2	49	MKWUP001	Community Service Program	2

39	MPA PA1	Research Proposal	2
40	MPA P04	Internship	3
41	PHY 403	Scientific Writing	2
42	MPA PA2	Final Project	4
43	PHY 503	Geographic Information System	3
44	PHY 507	Electromagnetic Methods	2
45	PHY 508	Volcanology and Geothermal	2
46	PHY 517	Biomaterial	2
47	PHY 511	Material Science	3
48	PHY 514	Semiconductor	2
49	PHY 513	Composite Physics	2
50	PHY 526	Introduction to Photonics	2
51	PHY 543	Introduction to Physics Radiology and Dosimetry	3
52	PHY 547	Health Physics and Radiation Protection	2
53	MPA P05	Entrepreneurial Practice	18
54	MPA P06	Industrial Internship	17
55	PHY 528	Electronics and Instrumentation Design	2
56	PHY 533	Sensors and Transducers	3
57	MPA P08	Scientific Publication	11
58	PHY 504	Introduction to Geophysics	2
59	PHY 502	Potential Field Survey	2
60	PHY 506	Seismic Methods	2
61	PHY 510	Geotechnics	2
62	PHY 552	Mineral and Rock Physics	2
63	PHY 554	Remote Sensing	2

50	SMPAP002	Research Proposal	2
51	SMPAP001	Internship	3
52	SPHY4075	Scientific Writing	2
53	SMPAPA01	Final Project	4
54	SPHY6025	Geographic Information System	2
55	SPHY6027	Practicum of Geographic Information System	1
56	SPHY6029	Electromagnetic Methods	2
57	SPHY6031	Volcanology and Geothermal	2
58	SPHY6033	Physical Geology	2
59	SPHY6035	Biomaterial	2
60	SPHY6037	Material Science	3
61	SPHY6039	Semiconductor	2
62	SPHY6041	Composite Physics	2
63	SPHY6043	Geometrical Optics	2
64	SPHY6045	Physical Optics	2
65	SPHY6047	Acoustics	2
66	SPHY6049	Photonics	2
67	SPHY6051	Light and Color	2
68	SPHY6053	Particle Physics	2
69	SPHY6055	Introduction to Radiological Physics	2
70	SPHY6057	Practicum Introduction to Radiological Physics	1
71	SPHY6059	Anatomy and Physiology	2
72	SPHY6061	Reactor Physics	2
73	SPHY6063	Dosimetry and Radiation Protection	2
74	SPHY6065	Biophysics	2
75	SMPAP003	Entrepreneurial Practice	17
76	SMPAP005	Industrial Internship A	17
77	SMPAP006	Industrial Internship B	11
78	SPHY6067	Electronics and Instrumentation Design	2
79	SPHY6069	Practicum of Electronics and Instrumentation Design	1
80	SPHY6071	Sensor and Transducer	2
81	SPHY6073	Practicum of Sensor and Transducer	1
82	SMPAP004	Scientific Publication	11
83	SPHY6036	Introduction to Geophysics	2
84	SPHY6038	Potential Field Survey	2
85	SPHY6040	Seismic Methods	2
86	SPHY6042	Geotechnics	2
87	SPHY6044	Mineral and Rock Physics	2
88	SPHY6046	Remote Sensing	2
89	SPHY6048	Practicum of Remote Sensing	1

64	PHY 515	Renewable Energy	2
65	PHY 516	Material Characterization	3
66	PHY 521	Introduction to Optoelectronics	2
67	PHY 522	Optical Communications	2
68	PHY 551	Basics Optometry	2
69	PHY 545	Introduction to Radiotherapy	2
70	PHY 549	Radiobiology	2
71	PHY 546	Introduction to Nuclear Medicine	2
72	PHY 548	Physics of Medical Imaging Klinis	2
73	PHY 530	Server and Computer Network System	2
74	PHY 527	Electronics System Programming	2
75	PHY 501	Meteorology and Weather Modeling	2
76	PHY 505	Data Analysis and Geophysics Modeling	2
77	PHY 509	Seismology	2
78	PHY 512	Magnetic Materials	2
79	PHY 524	Laser	2
80	PHY 519	Spectroscopy	2
81	PHY 539	Theoretical Physics Methods	2
82	PHY 541	Artificial Intelligence	2

90	SPHY6050	Special Topic of Geophysics	2
91	SPHY6052	Renewable Energy	2
92	SPHY6054	Material Characterization	2
93	SPHY6056	Practicum of Material Characterization	2
94	SPHY6058	Ceramic Physics	2
95	SPHY6060	Solar Cells	2
96	SPHY6062	Introduction to Optoelectronics	2
97	SPHY6064	Instrument Optics	2
98	SPHY6066	Laser and Spectroscopy Experiments	2
99	SPHY6068	Optical Communications	2
100	SPHY6070	Basics Optometry	2
101	SPHY6072	Introduction to Radiotherapy	2
102	SPHY6074	Radiobiology	2
103	SPHY6076	Introduction to Nuclear Medicine	2
104	SPHY6078	Physics of Medical Imaging	2
105	SPHY6080	Server and Computer Network System	2
106	SPHY6082	Practicum of Server and Computer Network System	1
107	SPHY6084	Embedded Electronic System	2
108	SPHY6086	Practicum of Embedded Electronic System	1
109	SPHY6088	Medical Instrumentation	2
110	SPHY6090	Practicum of Medical Instrumentation	1
111	SPHY6077	Meteorology and Weather Modeling	2
112	SPHY6079	Data Analysis and Geophysics Modeling	2
113	SPHY6081	Seismology	2
114	SPHY6083	Field Geophysics	2
115	SPHY6085	Geophysics and Meteorology Instrumentation	2
116	SPHY6087	Nano Materials	2
117	SPHY6089	Magnetic Materials	2
118	SPHY6091	Corrosion	2
119	SPHY6093	Laser	2
120	SPHY6095	Optical Instrumentation	2
121	SPHY6097	Spectroscopy	2
122	SPHY6099	Radiometry	2
123	SPHY6101	Photometry	2
124	SPHY6103	Theoretical Physics Methods	2
125	SPHY6105	Artificial Intelligence	2
126	SPHY6107	Analytical Mechanics	2

83	PHY 550	Radiotherapy Planning Klinis	2
84	PHY 553	Astronomy	2
85	MPA P07	Village Project	18
86	MPA P09	Teaching Practice	18
87	PHY 529	Sistem Digital dan Internet of Things	2
88	PHY 531	Data Communication and Telemetry	2
89	PHY 534	Control System and Mechatronics	3
90	PHY 540	Numerical Methods	2
91	PHY 542	Electrodynamics	2
92	PHY 532	Bioelectronics	2

127	SPHY6109	Radiotherapy Planning	2
128	SPHY6111	Introduction to Biomedical Engineering	2
129	SPHY6113	Astronomy	2
130	SMPAP007	Village Project A	18
131	SMPAP008	Village Project B	12
132	SMPAP009	Science Teaching Practice A	18
133	SMPAP010	Science Teaching Practice B	12
134	SPHY6115	Internet of Things (IoT)	2
135	SPHY6117	Practicum of Internet of Things (IoT)	1
136	SPHY6119	Data Communication and Telemetry	2
137	SPHY6121	Practicum of Data Communication and Telemetry	1
138	SPHY6123	Control System and Mechatronics	2
139	SPHY6125	Practicum of Control System and Mechatronics	1
140	SPHY6092	Photography and Videography Optics	2
141	SPHY6094	Laser Semiconductor	2
142	SPHY6096	Numerical Methods	2
143	SPHY6098	Electrodynamics	2
144	SPHY6100	Relativity Physics	2
145	SPHY6102	Bioelectronics	2
146	SPHY6104	Signal Processing	2
147	SPHY6106	Practicum of Signal Processing	1

*****_Courses that change codes, course names, and credits must be equivalent. The principle of equivalence is as far as possible not to disadvantage students._

3.8.2 List of Course Recognitions

List the recognition of regular courses with MBKM activities.*

Contoh :

Tabel 10. Matakuliah reguler dan MKRU yang dapat diekivalensi/dikognisi dengan kegiatan MBKM

Kode & Nama Matakuliah pilihan/wajib	Kegiatan MBKM	Kode* & Nama Mata Kuliah MKRU
001 Sosiologi Pedesaan (2SKS)		Kode : Komunikasi dan Kerjasama Kelompok (2 SKS)
	Proyek di desa	Kode : Berfikir kreatif dan Inovasi (2SKS)
		Kode : Teknik Negosisasi dan Adaptasi (2 SKS)
003 KKN (2SKS)		Kode : Pengembangan Talenta (2SKS)
		Kode : Manajemen Event (2 SKS)
		Kode: Keberagaman, Multibudaya dan Toleransi (2 SKS)
		Kode: Pengembangan Masyarakat (2 SKS)
		Kode: Pemikiran Inovasi dan Desain (2 SKS)
		Kode : Ketekunan dan Berfikir Analitis (2 SKS)
		Kode : Kreativitas Pemecahan Masalah (2 SKS)

*kode akan diberikan oleh UPT TIK

Banda Aceh, ...

Koordinator Program Studi ...

Tanda tangan

Nama
NIP

**Study programs must prepare a number of regular courses or MKRU courses (University Recognition Courses provided by USK) to anticipate if there are no regular courses suitable for recognition of MBKM activities taken by students. The code and name of MKRU will be prepared by the academic field and the code will be given by UPT TIK uniformly for all study programs. This MKRU will be registered with PDdikti but not provided as a regular course in the study program. The equivalence and recognition model is as shown in Table 10.*

3.9 Contoh RPS Metode Kasus dan Proyek Berbasis Tim/PjBL Program Studi

3.9.1 Contoh RPS Gabungan Metode Cased dan Team Based Project

Link: [RPS SOLAR CELLS_OBE.xlsx - Google Sheets]

UNIVERSITAS SYIAH KUALA
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
BACHELOR IN PHYSICS STUDY PROGRAM

Document Code: RPS-SPHY-6022

SEMESTER LEARNING PLAN

Course Title	Course Code	Category	Prerequisite Course	Course Cluster	Credit Point (SKS)		Semester	Date of Preparation
SOLAR CELL	SPHY6060	ELECTIVE	-	APPLIED	T=2	P=0	VI	Thursday, February 1, 2024

AUTHORIZATION	RPS Development Coordinator	Course Coordinator	Head of Study Program
	Dr. Mursal, M.Si	Dr. Mursal, M.Si	Dr. Saumi Syahreza, M.Si.

Lecture in Charge	Dr. Mursal, M.Si ; Evi Yufita, M.Si
Brief Course Description	This course covers the development of solar cells, sunlight, the intensity of sunlight on the Earth's surface, and direct and diffuse solar radiation. Additionally, it covers the fundamental properties of semiconductor materials: crystal structure, intrinsic and extrinsic semiconductors, p-n junctions, the operating principles and output characteristics of solar cells, and solar cell efficiency degradation: the Steabler-Wronski effect (bulk effect theory, surface effect theory), and solar cell fabrication technology.

Learning Outcome

ILO-PS (Study Program Intended Learning Outcome/CPL) assigned to the course	
CPL02	Graduates are able to master theoretical concepts in physics and multidisciplinary fields related to physical phenomena by using relevant methods to solve simple physics problems accurately and systematically.
Course Learning Outcome (CLO/CPMK)	
CPMKM38	Students are able to explain the development of solar cells, solar radiation, basic properties of semiconductors and working principles of solar cells (CPL02)
CPMKM39	Students are able to explain the degradation of solar cell efficiency, characteristics of the p-i-n layer, tandem structure solar cells, solar cell fabrication, and solar power plants (CPL02)

Correlation Matrix between Intended Learning Outcomes (ILO) and Course Learning Outcomes (CLO)

Correlation of ILO to CLO			
CLO	ILO(%)		Weight of CLO (%)
	CPL02	CPL-	
CPMKM38	50	0	50
CPMKM39	50	0	50
Weight of ILO (%)	100	0	100

Alignment Matrix of CLO with University Vision, Sustainable Development Goals (SDGs), and Research-Based Learning (RBL)

Correlation of CLO to University Vision, SDGs, and Research-Based Learning (RBL)				
Aspect	CLO			
	CPMK-01	CPMK-02		
Sosio-Teknopreneur	-	-	-	-
SDGs ke-	-	-	-	-
Research Based Learning (RBE)	-	-	-	

Study Materials / Learning Materials

1. Solar cells, development of solar cells; Solar Radiation: Air mass one (AM1) radiation, direct and diffuse solar radiation. Light energy
2. Basic properties of semiconductors: Semiconductor materials, Crystal structure, effect of temperature on energy gap, direct and indirect band gap semiconductors, intrinsic and extrinsic semiconductors, doping in semiconductors, intrinsic and extrinsic charge carrier density.
3. Solar cells: working principle and output characteristics of solar cells.
4. Solar power generation (PLS)
4. Solar cell materials: crystalline silicon (c-Si), amorphous silicon (a-Si), and hydrogenated amorphous silicon (a-Si:H)
5. Solar cell design and fabrication technology: PECVD, HW-PECVD, HWC-PECVD

Learning Resources / References

Main Reference:
1.Martin A.Green, Solar Cells, Operating principles Technololgy and System Aplycations, University on New south wales, Australia.
2.A. R. Jha,Phd, 2010, Solar cell thecnology and application, by Taylor and Francis Group, LLC
3.Lewis M Fraas, Larry D _Partain, 2019,Solar Cells and their applications, A JOHN WILEY & SONS, INC., PUBLICATION
4.Stephen J. Fonash, , 2010, Solar Cell Device Physics, Second Edition, AMSTERDAM • BOSTON • HEIDELBERG • LONDON NEW YORK • OXFORD •PARIS • TOKYO
5. Takahashi, K. dan Konagai, M. (1986) : Amorphous Silicon Solar Cells, Nort Oxford Academic, London.

Supporting Reference:

Assessment Criteria

Criteria and Assessment Items

Score Range	Letter Grade	Category	Graduation Status
≥87	A	Excellent	PASS
78 - <87	AB	Good	
69 - <78	B	Fairly Poor	
60 - <69	BC	Average	
51 - <60	C	Fair	
41 - <51	D	Poor	FAIL
<41	E	Fail	

Assessment Plan

Learning Method :		Case Method/Team-Based Project*)	√	Non Case Method/Team-Based Project*)	-

Assessment Basis	Assessment Components	Weight Distribution / CLO(%)				Total Weight of Team-Based Case/Project Method / Total CLO	Total Weight of Non-Case/Team-Based Project Method /Total CLO
		CPMKM38	CPMKM39				
		50%	50%				
Participatory Activities	Case Method (makalah+presentasi)	60	60	-		60.0	
Project Results	Team-Based Project	-			-	0.0	
Cognitive/Knowledge	Assignment T1	10					5.0
Cognitive/Knowledge	Assignment T2		10				5.0
Cognitive/Knowledge	Midterm Exam (UTS)	30					15.0
Cognitive/Knowledge	Final Semester Exam (UAS)		30				15.0
Total Weight / CLO		100	100	0	0	60.0	40.0
Kesimpulan Jenis Metode Pembelajaran		Case Method/Team-Based Project					

*) Note: For Case Method and PjBL/Team-Based Project (participatory activities and project results), the cumulative assessment weight is at least 50%.

SCHEDULE, MATERIAL DESCRIPTION, AND LECTURE ACTIVITIES

Week-	Final Competency for Each Learning Stage (Sub-CLO)	Assessment		Forms of Learning, Learning Methods, and Student Assignments [Estimated Time]		Learning Materials [References]	Assessment Weight (%)
		Indicators	Criteria & Techniques	Lecture	Independent work		
1	Understanding the concepts and principles of solar cells: understanding the history and development of solar cells (CPMKM38)+C86:T89C86:S89P92C86:T91C86:T89C86:T87C86:T89C86:T91P92C86:T91C86:T90C86:T91C86:T92P90C86:T91	(1) Accuracy in explaining the development of solar cells	**Criteria:** Accuracy and Mastery **Assessment Techniques:** - Non-test: - Test:	• Lecture: PBL [PB: 1 week x (2 SKS x 50")]	• Course Materials [KM: 1 week x (2 SKS x 120")]	**Introduction:** solar cell development	0.00%
2	Understanding the concept of solar energy(CPMKM38)	(1) Accuracy in explaining the concepts of energy and the properties of light	Criteria: Accuracy and Mastery Assessment Techniques: - non-test: - - test: -	• Lecture: PBL [PB: 1 week x (2sks x 50")]	• Course Materials [PT: 1 week x (2sks x 60")] [KM: 1 week x (2sks x 60")]	**Light Energy:** Properties of light energy, wave-particle duality, solar spectrum, solar constant, intensity of sunlight on the Earth's surface, solar radiation: air mass one (AM1) radiation, direct and diffuse solar radiation.	0.00%
3-4	Ability to explain the basic properties of semiconductors (CPMKM38).	1) Accuracy in explaining the concept of solar radiation	Criteria: Accuracy and Mastery Assessment Techniques: - non-test: - - test: -	• Lecture: PBL [PB: 2 week x (2sks x 50")]	• Course Materials [PT: 2 week x (2sks x 60")] Students are assigned to read and summarize the material or read about the issues. [KM: 2 week x (2sks x 60")] After the face-to-face meeting, students are given independent assignments.	**Basic properties of semiconductors:** Semiconductor materials, crystal structure, effect of temperature on energy gap, direct and indirect bandgap semiconductors, intrinsic and extrinsic semiconductors, doping in semiconductors, intrinsic and extrinsic charge carrier density.	5.00%
				Assignment I: Solar radiation [PT: 1 week x (2sks x 60")] [KM: 1 week x (2sks x 60")]			
5	Ability to explain photovoltaic materials: c-Si, a-Si, a-Si:H (CPMKM38)	Presentation topic case 1: (CPMK+C86:T86M38): 1. The development of solar cell technology from its inception to the present day. 2. Materials and technological innovations in solar cell manufacturing. 3. Improvement in solar panel efficiency	**Criteria:** Accuracy and Mastery **Assessment Techniques:** - non-test: - - test: -	• Lecture: PBL [PB: 1 week x (2sks x 50")]	• Course Materials [PT: 1 week x (2sks x 60")] [KM: 1 week x (2sks x 60")]	Photovoltaic Materials: c-Si, a-Si, a-Si:H. **Group dvision**	0.00%
6	Ability to explain the types of connections in semiconductor devices. (CPMKM38)	Consistency and accuracy in explaining and answering questions	**Criteria:** Accuracy and Mastery **Assessment Techniques:** - non-test: - - test: -	• Lecture: PBL [PB: 2 week x (2sks x 50")] Presentation and discussion	• Course Materials [PT: 2 week x (2sks x 60")] [KM: 2 week x (2sks x 60")]	Semiconductor device junctions: p-n junction, p-i-n junction	0.00%
7	Ability to explain and analyze the working principles and characteristics of photovoltaic cells. (CPMKM38)	Consistency and accuracy in explaining and answering questions	Case Method: • Case Presentation • Question and Answer Session, • Case 1: Write a paper on solar cells and their development; 1. The development of solar cell technology from its inception to the present. 2. Materials and technological innovations in solar cell manufacturing. 3. Improving the efficiency	• Lecture: PBL [PB: 2 week x (2sks x 50")] Presentation and discussion	• Course Materials [PT: 2 week x (2sks x 60")] [KM: 2 week x (2sks x 60")]	Presentation Topic 1: (CPMKM38): 1. The development of solar cell technology from its inception to the present day. 2. Materials and technological innovations in solar cell manufacturing. 3. Improving the efficiency of solar panels.	30.00%
8	**MIDTERM (CPMKM38)**						15.00%
9	Ability to explain the concepts and factors that influence the degradation of photovoltaic cell efficiency. (CPMKM39)	(1) Accuracy in explaining the Steabler-Wronski effect (2) Accuracy in explaining the bulk effect theory (3) Accuracy in explaining the surface effect theory	**Criteria:** Accuracy and Mastery **Assessment Techniques:** - non-test: - - test: -	• Lecture: PBL [PB: 1 week x (2sks x 50")]	• Course Materials [PT: 1 week x (2sks x 60")] [KM: 1 week x (2sks x 60")]	Photovoltaic Cell Efficiency Degradation: Steabler-Wronski Effect, Bulk Theory, Surface Effect Theory. **Group division**	0.00%
10	Ability to explain the characteristics of p, I, and n layers for photovoltaic cell applications. (CPMKM39)	Accuracy in understanding the characteristics of p-type, I-type, and n-type semiconductor materials for photovoltaic cell applications.	**Criteria:** Accuracy and Mastery **Assessment Techniques:** - non-test: - - test: -	• Lecture: PBL [PB: 1 week x (2sks x 50")]	• Course Materials • [PT: 1 week x (2sks x 60")] [KM: 1 week x (2sks x 60")]	Characteristics of photovoltaic cell layers and their influence on photovoltaic cell characteristics.	0.00%
11-12	Ability to explain double junction and multi-junction models in photovoltaic cells. (CPMKM39)	(1) Accuracy in explaining the concept of Solar Cell Design	**Criteria:** Accuracy and Mastery **Assessment Techniques:** - non-test: - - test: -	• Lecture: PBL [PB: 2 week x (2sks x 50")]	• Course Materials dan Penugasan • [PT: 2 week x (2sks x 60")] [KM: 2 week x (2sks x 60")]	Double Junction and Triple Junction Photovoltaic Cells **Group division**	5.00%
				Assignment II: Solar cell design [PT: 1 week x (2sks x 60")] [KM: 1 week x (2sks x 60")]			
13	Ability to explain the concept of solar cell fabrication technology. (CPMKM39)	(1) Accuracy in explaining the concept of solar cell fabrication technology	**Criteria:** Accuracy and Mastery **Assessment Techniques:** - non-test: - - test: -	• Lecture: PBL [PB: 1 week x (2sks x 50")]	• Course Materials • Assignment [PT: 1 week x (2sks x 60")] [KM: 1 week x (2sks x 60")]	Solar cell fabrication technology	0.00%
14-15	Ability to design simple solar power systems. (CPMKM39)	Consistency and accuracy in explaining and answering questions	Case Method: • Case Presentation • Question and Answer Session, • Case 2 on: 1. efficiency degradation due to hotspots, 2. increasing solar cell efficiency with multi-junction structures, 3. characteristics of p-type, I-type, and n-type	• Lecture: PBL [PB: 2 week x (2sks x 50")] Presentation and discussion	• Course Materials [PT: 2 week x (2sks x 60")] [KM: 2 week x (2sks x 60")]	Solar Power Plant (PLTS) Presentation Topic (CPMK39).	30.00%
16	**FINAL (CPMKM39)**						**25.00%**
	TOTAL WEIGHT						**100.00%**

Notes:

1	**Program Study Intended Learning Outcomes (ILO-SP)** are the abilities possessed by each graduate of a study program, which are the internalization of attitudes, mastery of knowledge, and skills following the level of the study program, obtained through the learning
2	**ILO charged to the course are several learning outcomes of program graduates (ILO-SP) used for the formation/development of a course consisting of aspects of attitude, general skills, specific skills, and knowledge.**
3	**Course Learning Outcomes (CLO/CPMK)** are specific abilities described in the ILO that are assigned to a course and are specific to the subject matter or learning material of that course.
4	**Sub-Course Learning Outcomes (Sub-CLO)** are specific abilities described in detail from CLO that can be measured or observed and are the final abilities planned for each stage of learning, and are specific to the course material.
5	**Assessment indicators** for student learning processes and outcomes are specific and measurable statements that identify student learning abilities or performance, accompanied by evidence.
6	Assessment criteria are benchmarks used as measures or standards for learning achievement in assessments based on predetermined indicators. Assessment criteria serve as guidelines for assessors to ensure that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7	Assessment Techniques: test and non-test
8	**Forms of Learning:** Lectures, Quizzes, Tutorials, Seminars or equivalent, Practicums, Studio Practice, Workshop Practice, Field Practice, Research, Community Service, and/or other forms of learning.
9	**Lecture:** Face-to-face learning, also known as offline learning, is a learning concept that takes the form of a conventional learning model and brings lecturers and students together in one room to study.
10	**Independent work** is an online learning process that can be categorized into two types, namely independent learning and guided learning. The learning process can be synchronous (simultaneous) or asynchronous (not simultaneous) and a maximum of 35% of the total number of meetings (5 meetings).
11	**Learning Methods:** Small Group Discussion, Role-playing and Simulation, Discovery Learning, Independent Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project-based Learning, and other equivalent methods.
12	**Learning materials** are details or descriptions of study materials that can be presented in the form of several main topics and subtopics.
13	**The Weighting** is the percentage of assessment for each sub-CLO achievement, which is proportional to the level of difficulty of the sub-CLO achievement and totals 100%.
14	**PB** = Learning Process, **PT** = Structured Assignment, **KM** = Independent Activity.
15	**Sustainable Development Goals (SDGs):** 17 Sustainable Development Goals, namely (1) No Poverty; (2) Zero Hunger; (3) Good Health and Well-being; (4) Quality Education; (5) Gender Equality; (6) Clean Water and Sanitation; (7) Affordable and Clean Energy; (8) Decent Work and Economic Growth; (9) Industry, Innovation, and Infrastructure; (10) Reduced Inequalities; (11) Sustainable Cities and Communities; (12) Responsible Consumption and Production; (13) Climate Action; (14) Life Below Water; (15) Life on Land; (16) Peace, Justice, and Strong Institutions; (17) Partnerships for the Goals. (https://www.timeshighereducation.com/impactrankings)
16	**Socio-Technopreneur** is the ability to solve problems that exist in the community by utilizing the resources available in the surrounding environment. The course is designed to cover the necessary skills, such as entrepreneurship, innovation, project management, and technical aspects in the field of information technology.
17	**Research-Based Learning (RBL)** is a multi-aspects learning method that refers to various learning and teaching strategies that connect research and teaching.

3.9.2 Example of Project-Based / Project-Team-Based RPS

Link: [SPHY 6040 Kedokteran Nuklir (Project-based) kurikulum OBE 2024.xlsx - Google Sheets]

UNIVERSITAS SYIAH KUALA
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
BACHELOR IN PHYSICS STUDY PROGRAM

Document Code 45201-39-01-03

SEMESTER LEARNING PLAN

Course Title	Course Code	Category	Prerequisite Course	Course Cluster	Credit Point (SKS)		Semester	Date of Preparation
Introduction to Nuclear Medicine	SPHY6076	Elective			T = 2	P = 0	VI	20 Maret 2024

AUTHORIZATION	RPS Development Coordinator	Course Coordinator	Head of Study Program
	(Prof. Dr. Eng. Elin Yusibani, S.Si., M.Eng)	(Dr. Rini Safitri, S.Si., M.Si)	(Dr. Saumi Syahreza, S.Si., M.Si)

Lecture in Charge: Prof. Dr. Eng. Elin Yusibani, S.Si., M.Eng, Dr. Rini Safitri, S.Si., M.Si, Praktisi

Brief Course Description: Students will gain understanding of the basic principles of nuclear medicine and how it differs from general radiology. They will be able to understand the process of radionuclide formation and how radiopharmaceuticals are manufactured. They will be able to understand the image formation process in nuclear medicine using ET, SPECT, and PET techniques. They will be able to understand several applications of radioisotopes in medicine and pharmacy.

Learning Outcome

ILO-PS (Study Program Intended Learning Outcome/CPL) assigned to the course

CPL01	Graduates demonstrate religious attitudes and good social character by applying applicable scientific norms and ethics to become lifelong learners (S+PP).
CPL02	Graduates are able to master theoretical concepts in physics and multidisciplinary fields related to physical phenomena using relevant methods to solve simple physics problems accurately and systematically (PP).

Course Learning Outcome (CLO/CPMK)

CPMKS28	Students are able to demonstrate punctuality, academic ethics, responsibility in completing assignments, and the ability to work together with fellow students without discriminating based on ethnicity, religion, race, culture, or differences in opinion (CPL1).
CPMKS29	Students are able to explain the process of radionuclide formation and how radiopharmaceuticals are made (CPL2).
CPMKS30	Students are able to explain the basic principles of nuclear medicine (gamma camera, PET, SPECT) and distinguish them from general radiology (CPL2).

Correlation Matrix between Intended Learning Outcomes (ILO) and Course Learning Outcomes (CLO)

Correlation of ILO to CLO

CLO	ILO (%)		Weight of CLO (%)
	CPL01	CPL02	
CPMKS28	20	0	20
CPMKS29	0	40	40
CPMKS30	0	40	40
Weight of ILO (%)	20	80	100

Alignment Matrix of CLO with University Vision, Sustainable Development Goals (SDGs), and Research-Based Learning (RBL)

Korelasi CPMK terhadap Visi Universitas, SDGs, dan RBL

Aspect	CLO		
	CPMKS28	CPMKS29	CPMKS30
Sosio-Technopreneur		-	-
SDGs		3(Good health and well being)	
Research Based Learning (RBL)		-	-

Study Materials / Learning Materials

1. Introduction to the basic concepts of nuclear medicine
2. Radioactivity decay, decay schemes
3. Radionuclides and Nuclear transformations
4. In-Vivo and In-Vitro Studies in Nuclear Medicine
5. Radionuclide Formation Process
6. Image Formation Process in nuclear medicine instruments such as: Emission Tomography, SPECT, PET
7. Radioisotope Applications in Medicine as Tracer Technique

Learning Resources / References

Main Reference:

1. J. T. Bushberg, J. A. Seibert, E. M. Leidholdt, Jr., J. M. Boone. The Essential Physics of Medical Imaging, 2nd ed., Williams and Wilkins, Baltimore, MD, 2002.
2. P.P Dendy and B. Heaton. Physics of Diagnostic Radiology, Institute of Physics Publishing, London, UK, 1999.
3. P. Sprawl. Physical Principles of Medical Imaging, Aspen Publishers,. Gaithersburg, Maryland, 1987.

Supporting Reference:

4. AAPM Report No. 39. Specification and Acceptance Testing of Computed Tomography Scanners, American Institute of Physics, New York,1993.
5. AAPM Report no. 76. Quality Control in Diagnostic Radiology, American Institute of Physics, New York, 2002.

Assessment Criteria

Criteria and Assessment Items

Score Range	Letter Grade	Category	Graduation Status
≥87	A	Excellent	PASS
78 - <87	AB	Good	
69 - <78	B	Fairly Poor	
60 - <69	BC	Average	
51 - <60	C	Fair	
41 - <51	D	Poor	FAIL
<41	E	Fail	

Assessment Plan

Learning Method : Case Method/PjBL: Ö | Non Case Method/Team-Based Project: x

Assessment Basis	Assessment Components	Weight Distribution / CLO(%)			Total Weight of Case Method/Team-Based Project	Total Weight of Non Case Method/Team-Based Project
		CPMKS28	CPMKS29	CPMKS30		
		20%	40%	40%		
Project Results	Team-Based Project					
	Case 1	40.00	50.00	0.00	28.00	
	Case 2	40.00	0.00	50.00	28.00	
Participatory Activities	Case method	0.00	0.00	0.00	0.00	
Cognitive/Knowledge	Midterm Exam (UTS)	10.00	50.00	0.00		22.00
Cognitive/Knowledge	Final Semester Exam (UAS)	10.00	-	50.00		22.00
Total Weight / CLO		100.00	100.00	100.00	56.00	44.00
Kesimpulan Jenis Metode Pembelajaran		Case Method/PjBL				

SCHEDULE, MATERIAL DESCRIPTION, AND LECTURE ACTIVITIES							
Week-	Final Competency for Each Learning Stage (Sub-CLO)	Assessment		Forms of Learning, Learning Methods, and Student Assignments [Estimated Time]		Learning Materials [References]	Assessment Weight (%)
		Indicators	Criteria & Techniques	Lecture	Independent work		
1	(1) Orientation to nuclear medicine courses (2) Students are able to explain the basic principles of nuclear medicine and distinguish it from radiology in general.	(1) Introduction to RPS and Course Contracts Introduction. (2) Students have the ability to understand general concepts of nuclear medicine	**Model:** Teacher-Based Learning **Scenario:** Introducing the course syllabus and project-based learning course contract, dividing students into groups, providing in-depth material, students searching for papers for case study 1	Lecture [PB: 1 week x (2sks x 50')]	[PT: 1 week x (2sks x 60')] [KM: 1 week x (2sks x 60')]	a. Lecture contract and introduction to course syllabus b. Introduction to Nuclear Medicine for physicists	
2	(1) Able to understand the process of radioactivity formation in atoms (2) Able to communicate scientifically well, both verbally and in writing.	Ability in the learning process and outcomes, as well as specific and measurable statements that identify the abilities or performance of student learning outcomes in accordance with the expected subCLO. Students analyze scientific papers with narrative and descriptive themes.	Criteria: Rubric Scenario: • Lecture • Question and answer session	Lecture [PB: 1 week x (2sks x 50')]	[PT: 1 week x (2sks x 60')] [KM: 1 week x (2sks x 60')]	a. Radioactive Decay b. Decay Scheme	
3	Able to understand the process of radionuclide formation and how radiopharmaceuticals are made.	This learning is project-based, so students will create scientific posters about the cases given.	Criteria: Rubric Project based: • Case Presentation • Question and Answer Session • Case 1: How to manufacture and how radio pharmaceuticals work for nuclear medicine purposes	Lecture [PB: 1 week x (2sks x 50')]	[PT: 1 week x (2sks x 60')] [KM: 1 week x (2sks x 60')]	Radionuclides and Natural Nuclear Transformations	
4	(1) Students are able to explain the process of radionuclide formation and production (2) Students are able to explain the process of radiopharmaceutical production	(1) Group learning analyzing scientific papers on the formation of radiopharmaceuticals (2) Accuracy in identifying problems (3) Accuracy in using appropriate methods to solve problems (4) Accuracy in creating programs	student center learning	Lecture [PB: 1 week x (2sks x 50')]	[PT: 1 week x (2sks x 60')] [KM: 1 week x (2sks x 60')]	1. Radiology 2. Radionuclide Formation Process 3. Radionuclide Production 4. Radiopharmaceuticals	
5,6,7	Students are able to disseminate their learning outcomes in groups.	Abilities in the learning process and outcomes of students, as well as specific and measurable statements that identify the abilities or performance of student learning outcomes in accordance with the expected subCPMK.	presentation of learning outcomes in groups by conducting a poster session	Poster presentation [PB: 1 week x (2sks x 50')]	[PT: 1 week x (2sks x 60')] [KM: 1 week x (2sks x 60')]	complete the selected case in the form of a poster as the project outcome	28
8	UJIAN TENGAH SEMESTER (CPMK 1, CPMK 2)						22
9	The student explained the process of image formation in nuclear medicine using Emission Tomography (ET), SPECT, and PET techniques.	Abilities in the learning process and outcomes of students, as well as specific and measurable statements that identify the abilities or performance of student learning outcomes in accordance with the expected subCPMK.	Criteria: Rubric Skenario: • Lecture • Tanya-Jawab	Lecture [PB: 1 week x (2sks x 50')]		a. Image Formation Process b. Emission Tomography (ET) c. SPECT (Single Photon Emission Computed Tomography) d. PET (Positron Emission Tomography)	
10	Students are able to explain several applications of radioisotopes in the fields of medicine and pharmacy.	Abilities in the learning process and outcomes of students, as well as specific and measurable statements that identify the abilities or performance of student learning outcomes in accordance with the expected subCPMK.	Criteria: Rubric Skenario: • Lecture • Tanya-Jawab	Lecture [PB: 1 week x (2sks x 50')]	[PT: 1 week x (2sks x 60')] [KM: 1 week x (2sks x 60')]	a. Radioisotope Applications in Medicine as Tracers (Tracer Technique) b. Radioisotope Applications in Pharmacy for Kidney Function Tests and Thyroid Function Tests	
11	Students are able to distinguish when to use CTSCAN, PET, and SPECT in diagnosing a disease.	This learning is project-based, so students will create scientific posters about the cases given.	Criteria: Rubric Project based: • Case Presentation • Question and Answer Session • Case 2: There is a patient with medical problems. Explain the examination procedures that the patient must undergo, using the PET strategy: 1. Students will be divided into two working groups that will explain the function of nuclear tracers. 2. Students will discuss and solve the given case in groups.	Lecture [PB: 1 week x (2sks x 50')]	[PT: 1 week x (2sks x 60')] [KM: 1 week x (2sks x 60')]	a. Image Formation Process b. Emission Tomography (ET) c. SPECT (Single Photon Emission Computed Tomography) d. PET (Positron Emission Tomography)	

12	(1) Students are able to explain the process of image formation using a gamma camera. (2) Students are able to explain the process of image formation using PET/SPECTs.	(1) Group learning analyzing scientific papers on the formation of radiopharmaceuticals (2) Accuracy in identifying problems (3) Accuracy in using appropriate methods to solve problems (4) Accuracy in creating programs	student center learning	Lecture [PH: 2mg x (2sks x 50")]	[PT: 1 week x (2sks x 60")] 1 week x (2sks x 60")]	[KM:	case resolution 2	
13;14;15	Students are able to disseminate their learning outcomes in groups.	Abilities in the learning process and outcomes of students, as well as specific and measurable statements that identify the abilities or performance of student learning outcomes in accordance with the expected subCLO.	presentation of learning outcomes in groups by conducting a poster session	Presentasi poster [PH: 1 week x (2sks x 50")]	[PT: 1 week x (2sks x 60")] 1 week x (2sks x 60")]	[KM:	case resolution 2	28
16	FINAL (CPMK 1, CPMK 3)							22
							TOTAL WEIGHT	**100**

Catatan:

1	**Program Study Intended Learning Outcomes (ILO-SP)** are the abilities possessed by each graduate of a study program, which are the internalization of attitudes, mastery of knowledge, and skills following the level of the study program, obtained through the
2	**ILO charged to the course are several learning outcomes of program graduates (ILO-SP) used for the formation/development of a course consisting of aspects of attitude, general skills, specific skills, and knowledge.**
3	**Course Learning Outcomes (CLO/CPMK)** are specific abilities described in the ILO that are assigned to a course and are specific to the subject matter or learning material of that course.
4	**Sub-Course Learning Outcomes (Sub-CLO)** are specific abilities described in detail from CLO that can be measured or observed and are the final abilities planned for each stage of learning, and are specific to the course material.
5	**Assessment indicators** for student learning processes and outcomes are specific and measurable statements that identify student learning abilities or performance, accompanied by evidence.
6	Assessment criteria are benchmarks used as measures or standards for learning achievement in assessments based on predetermined indicators. Assessment criteria serve as guidelines for assessors to ensure that assessments are consistent and unbiased.
7	Assessment Techniques: test and non-test
8	**Forms of Learning:** Lectures, Quizzes, Tutorials, Seminars or equivalent, Practicums, Studio Practice, Workshop Practice, Field Practice, Research, Community Service, and/or other forms of learning.
9	**Lecture:** Face-to-face learning, also known as offline learning, is a learning concept that takes the form of a conventional learning model and brings lecturers and students together in one room to study.
10	**Independent work** is an online learning process that can be categorized into two types, namely independent learning and guided learning. The learning process can be synchronous (simultaneous) or asynchronous (not simultaneous) and a maximum of 35% of
11	**Learning Methods:** Small Group Discussion, Role-playing and Simulation, Discovery Learning, Independent Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project-based Learning, and other equivalent methods.
12	**Learning materials** are details or descriptions of study materials that can be presented in the form of several main topics and subtopics.
13	**The Weighting** is the percentage of assessment for each sub-CLO achievement, which is proportional to the level of difficulty of the sub-CLO achievement and totals 100%.
14	**PB** = Learning Process, **PT** = Structured Assignment, **KM** = Independent Activity.
15	**Sustainable Development Goals (SDGs):** 17 Sustainable Development Goals, namely (1) No Poverty; (2) Zero Hunger; (3) Good Health and Well-being; (4) Quality Education; (5) Gender Equality; (6) Clean Water and Sanitation; (7) Affordable and Clean Energy;
16	**Socio-Technopreneur** is the ability to solve problems that exist in the community by utilizing the resources available in the surrounding environment. The course is designed to cover the necessary skills, such as entrepreneurship, innovation, project management, and technical aspects in the field of information technology.
17	**Research-Based Learning (RBL)** is a multi-aspects learning method that refers to various learning and teaching strategies that connect research and teaching.

Present one example each of the RPS for courses that use the Case Method and Team-based Project / PJBL method (See the RPS format in the USK 2023 curriculum guidebook, and can be accessed at the following GDrive link https://bit.ly/format-rps-usk)

3.10 Sample Course Contract for Study Program

Present one example of a Course Contract (see the Course Contract format on the following GDrive link https://bit.ly/format-kontrakkuliah-usk)

CHAPTER 4
LEARNING PROGRAM EVALUATION DESIGN

4.1 Relationship between Graduate Profile and Intended Learning Outcomes (ILO)

Table 4.1. Relationship Matrix between Graduate Profiles and ILOs

Graduate Profile	PL-01	PL-02	PL-03	PL-04
CPL-01	H	H	H	H
CPL-02	H	H	M	M
CPL-03	H	H	H	H
CPL-04	M	H	M	H
CPL-05	M	M	H	H

**Organization of ILO and PL codes is left to each study program*
**Description: L = Low (0-40) M = Medium (41-70); H = High (71-100)*

To track graduate competencies, the following matrix of SKL (SNDIKTI/KKNI) and ILO linkages can be used.

Table 4.2. ILO Linkage Matrix (SNDikti/KKNI) with SKL components (attitude, knowledge, general skills, specific skills). SKL is a term in SNDikti that is actually the same as ILOs

Competence (SKL)*	CPL-01	CPL-02	CPL-03	CPL-04	CPL-05
Attitude (S)	√				√
Knowledge (P)	√	√		√	√
General Skills (KU)					√
Special Skills (KK)			√	√	

*in Permendikbudristek No. 53 of 2023 does not have to be detailed in the CLO.

4.2 Course Relationship with Intended Learning Outcomes (ILO)

Contoh matriks kontribusi capaian ILO dari mata kuliah sepertI berikut ini:

Choose courses that have the highest (H) relation to the achievement of an ILO. ILO assessment can be done by taking sample assessments from CLO that contribute to the ILO. Each ILO is measured by at least 3 courses. Examples of ILO weight calculations from semester 1-8 can be seen in Table 4.3. For example in table 4.3, ILOs are coded A, B, C, etc. An example of course contribution to the achievement of ILO is shown in the Materials Analysis Practicum course (2 SKS), which contributes to ILO C and ILO I. Material Analysis Practicum has a total of 2 SKS, so it is determined (teaching team and study program) that ILO C (75% related or 1.5 SKS) and ILO I (25% related or 0.5 SKS). The assessment percentage for a particular ILO is calculated from the total number of

that ILO divided by the total ILO credits (37). For example, ILO A totals 4.4; then (4.4/37)x100% = 12%.

Table 4.3. Example of ILO weight calculation matrix of Bachelor in Physics Study Program, USK

No	SMT	CODE	COURSE NAME	ILO*						
				SKS	1	2	3	4	5	total
1	1	MKWU1002	Civic Education	2	2					2
2	1	MKWU1005	Disaster Management and Environment	2	0.5		1.5			2
3	1	MKWU1006	Character Building 1	0						0
4	1	SMPA 1001	Introduction to Calculus	3	0.6	0.4	0.8		1.2	3
5	1	SMPA 1003	Introduction to Physics	2		0.2	1.8			2
6	1	SPHY1001	Practicum of Introduction to Physics	1	0.3		0.7			1
7	1	SMPA 1005	Introduction to Chemistry	2	0.5	0.4	1.1			2
8	1	SMKM1001	Practicum of Introduction to Chemistry	1	0.3		0.7			1
9	1	SMPA 1007	Introduction to Biology	2	0.4		0.6		1	2
10	1	SMBI1001	Practicum of Introduction to Biology	1	0.4			0.6		1
11	1	SMPA P001	Statistical Methods	2	0.67	1.33				2
12	1	SMPA1009	Introduction to Industrial Revolution	2		0.2	1.8			2
13	2	MKWU1003	Indonesian Language	2		0.3	1.7			2
14	2	MKWU1001	Pancasila	2	0.4	0.6	1			2
15	2	MKWU1004	English	2	0.3	0.2	0.5	1		2
16	2	MKWU1007	Character Building II	0						0
17	2	SPHY 1002	Occupational Health and Safety	2	0.2	0.5		0.3	1	2
18	2	SPHY 1004	Fundamental of Physics	4	0.4	3.6				4
19	2	SPHY1006	Practicum of Fundamental of Physics	1	0.3		0.7			1
20	2	SPHY1008	Calculus of Physics	4		4				4
21	2	SPHY1010	Measurement and Calibration	2		0.2	1.8			2
22	2	SPHY1012	Practicum Measurement and Calibration	1	0.3		0.7			1
23	3	MKWU2001	Religion Education	2	0.3	0.2	0.5		1	2
24	3	SPHY 2001	Mathematical Physics 1	4	0.7	1.4	1.9			4

No	SMT	CODE	COURSE NAME	ILO*						
				SKS	1	2	3	4	5	total
25	3	SPHY 2005	Modern Physics	3		0.6	2.4			3
26	3	SPHY 2007	Thermodynamics	3	0.3	0.7	2			3
27	3	SPHY2009	Practicum of Thermodynamics	1	0.3		0.7			1
28	3	SPHY 2011	Electronics	3	0.7	0.3	1	1		3
29	3	SPHY2013	Practicum of Electronics	1	0.3		0.7			1
30	3	SPHY 2015	Algorithm and Programming	2	0.5			0.5	1	2
31	3	SPHY2017	Practicum of Algorithm and Programming	1	0.3		0.7			1
32	4	SPHY2014	Mathematical Physics II	4	0.7	1.4	1.9			4
33	4	SPHY2016	Waves	3	0.3	2.7				3
34	4	SPHY2018	Practicum of Waves	1	0.3	0.7				1
35	4	SPHY2020	Electromagnetics	3			0.6	2.4		3
36	4	SPHY2022	Practicum of Electromagnetics	1	0.3		0.7			1
37	4	SPHY2024	Mechanics	4	0.5	1.5	2			4
38	4	SPHY2026	Computational Physics	3	0.5	1.5	2			3
39	4	SPHY2028	Practicum of Computational Physics	1	0.3		0.7			1
40	5	SMPA3013	Entrepreneurship	2		1		1		2
41	5	SMPA3015	Practicum Entrepreneurship	1		0.3		0.7		1
42	5	SPHY3017	Optics	3	0.5	1	1	0.5		3
43	5	SPHY3019	Practicum of Optics	1		0.3		0.7		1
44	5	SPHY3021	Statistical Physics	3		0.6	2.4			3
45	5	SPHY3023	Quantum Physics	4	0.4	3.6				4
46	5	SPHY6025	Geographic Information System	2	0.4	1.6				2
47	5	SPHY6027	Practicum of Geographic Information System	1	0.3	0.7				1
48	5	SPHY6029	Electromagnetic Methods	2	0.8		1.2			2
49	5	SPHY6031	Vulcanology and Geothermal	2	0.7	1.3				2

No	SMT	CODE	COURSE NAME	ILO*						
				SKS	1	2	3	4	5	total
50	5	SPHY6033	Physical Geology	2	0.3	0.5	1.2			2
51	5	SPHY6035	*Biomaterial*	2	1	1				2
52	5	SPHY6037	Material Science	3	0.3	1.95		0.75		3
53	5	SPHY6039	Semiconductor	2		0.5	0.5	1		2
54	5	SPHY6041	Composite Physics	2	0.2	1		0.8		2
55	5	SPHY6043	Geometrical Optics	2	0.2	0.8	1			2
56	5	SPHY6045	Physical Optics	2	0.5	0.5	1			2
57	5	SPHY6047	Acoustics	2	1	1				2
58	5	SPHY6049	Photonics	2	0.5	0.5	1			2
59	5	SPHY6051	Light and Color	2		0.7	1.3			2
60	5	SPHY6053	Particle Physics	2	0.7	1	0.3			2
61	5	SPHY6055	Introduction to Radiological Physics	2		0.5	1.5			2
62	5	SPHY6057	Practicum Introduction to Radiological Physics	1	0.1	0.6	0.3			1
63	5	SPHY6059	Anatomy and Physiology	2	0.1	0.9	1			2
64	5	SPHY6061	Reactor Physics	2	0.2	1.8				2
65	5	SPHY6063	Dosimetry and Radiation Protection	2		0.5	1.5			2
66	5	SPHY6065	Biophysics	2		0.2	0.8	1		2
67	5	SMPAP003	Entrepreneurial Practice	17	5	1	1	5	5	17
68	5	SMPAP005	Industrial Internship A	17	5	1	1	5	5	17
69	5	SPHY6067	Electronics and Instrumentation Design	2		0.5		1.5		2
70	5	SPHY6069	Practicum of Electronics and Instrumentation Design	1	0.25			0.75		1
71	5	SPHY6071	Sensors and Transducers	2	0.25	0.75	1			2
72	5	SPHY6073	Practicum of Sensors and Transducers	1	0.3		0.7			1
73	6	SPHY3030	Nuclear Physics	3	0.3	2.7				3
74	6	SPHY3032	Research Methodology	2	0.7		0.5		0.8	2

No	SMT	CODE	COURSE NAME	ILO*						
				SKS	1	2	3	4	5	total
75	6	SPHY3034	Solid State Physics	4	0.4				3.6	4
76	6	SMPAP004	Scientific Publication	11	2	1	1	4	3	11
77	6	SMPAP006	Industrial Internship B	11	3	1	1	2	4	11
78	6	SPHY6036	Introduction to Geophysics	2	0.2	1.8				2
79	6	SPHY6038	Potential Field Survey	2	0.8			1.2		2
80	6	SPHY6040	Seismic Methods	2		0.2	1.8			2
81	6	SPHY6042	Geotechnics	2	0.2	0.3	1.5			2
82	6	SPHY6044	Mineral and Rock Physics	2		1	1			2
83	6	SPHY6046	Remote Sensing	2	0.2	0.3	1.5			2
84	6	SPHY6048	Practicum of Remote Sensing	1	0.3		0.7			1
85	6	SPHY6050	Special Topic of Geophysics	2		0.2	1.8			2
86	6	SPHY6052	Renewable Energy	2	0.4	1.6				2
87	6	SPHY6054	Material Characterization	2		1	1			2
88	6	SPHY6056	Practicum of Material Characterization	2	0.3	1.7				2
89	6	SPHY6058	Ceramic Physics	2	0.2	0.9	0.9			2
90	6	SPHY6060	Solar Cells	2			1.5	0.5		2
91	6	SPHY6062	Introduction to Optoelectronics	2	0.5	1.5				2
92	6	SPHY6064	Instrument Optics	2		0.2	0.3	1.5		2
93	6	SPHY6066	Laser and Spectroscopy Experiments	2		0.3	0.7			2
94	6	SPHY6068	Optical Communications	2		0.5	0.5	1		2
95	6	SPHY6070	Basics Optometry	2	0.5	1.5				2
96	6	SPHY6072	Introduction to Radiotherapy	2	0.2	1.8				2
97	6	SPHY6074	Radiobiology	2	2					2
98	6	SPHY6076	Introduction to Nuclear Medicine	2	0.4	1.6				2
99	6	SPHY6078	Physics of Medical Imaging	2	0.2	0.3	1	0.5		2

No	SMT	CODE	COURSE NAME	ILO*						
				SKS	1	2	3	4	5	total
100	6	SPHY6080	Server and Computer Network System	2	1	1				2
101	6	SPHY6082	Practicum of Server and Computer Network System	1	0.3	0.7				1
102	6	SPHY6084	Embedded Electronic System	2	1	1				2
103	6	SPHY6086	Practicum of Embedded Electronic System	1	0.2			0.8		1
104	6	SPHY6088	Medical Instrumentation	2	0.2		0.8	1		2
105	6	SPHY6090	Practicum of Medical Instrumentation	1	0.2		0.8			1
106	7	SMPAPA01	Final Project	4	0.4	0.8		1.2	1.6	4
107	7	SPHY6077	Meteorology and Weather Modeling	2	0.3		1.7			2
108	7	SPHY6079	Data Analysis and Geophysics Modeling	2	0.8		1.2			2
109	7	SPHY6081	Seismology	2	0.5	0.5	1			2
110	7	SPHY6083	Field Geophysics	2	0.2	1.8				2
111	7	SPHY6085	Geophysics and Meteorology Instrumentation	2			1	1		2
112	7	SPHY6087	Nano Materials	2	1	1				2
113	7	SPHY6089	Magnetic Materials	2	0.4			1.6		2
114	7	SPHY6091	Corrosion	2		1.5	0.5			2
115	7	SPHY6093	Laser	2	0.5	1.5				2
116	7	SPHY6095	Optical Instrumentation	2		1	1			2
117	7	SPHY6097	Spectroscopy	2	0.2	1.8				2
118	7	SPHY6099	Radiometry	2	0.2		0.8	1		2
119	7	SPHY6101	Photometry	2	0.3	1.7				2
120	7	SPHY6103	Theoretical Physics Methods	2		1		1		2
121	7	SPHY6105	Artificial Intelligence	2	0.2	1	0.8			2
122	7	SPHY6107	Analytical Mechanics	2		1	1			2
123	7	SPHY6109	Radiotherapy Planning	2		0.8	1.2			2
124	7	SPHY6111	Introduction to Biomedical Engineering	2	0.4		1.6			2

No	SMT	CODE	COURSE NAME	ILO*						
				SKS	1	2	3	4	5	total
125	7	SPHY6113	Astronomy	2		0.2	1.8			2
126	7	SMPAP007	Village Project A	18	6	1	1	5	5	18
127	7	SMPAP009	Science Teaching Practice A	18	5	1	1	5	6	18
128	7	SPHY6115	Internet of Things (IoT)	2	0.25	0.75		1		2
129	7	SPHY6117	Practicum of Internet of Things (IoT)	1	0.25			0.75		1
130	7	SPHY6119	Data Communication and Telemetry	2	0.75	1	0.25			2
131	7	SPHY6121	Practicum of Data Communication and Telemetry	1	0.25	0.75				1
132	7	SPHY6123	Control System and Mechatronics	2	1		1			2
133	7	SPHY6125	Practicum of Control System and Mechatronics	1	0.1			0.9		1
134	8	SMPAPA01	Final Project	4	0.9	1	2.1			4
135	8	SMPAP008	Village Project B	12	5	1	1	2	2	12
136	8	SMPAP010	Science Teaching Practice B	12	1	1	1	4	5	12
137	8	SPHY6092	Photography and Videography Optics	2	1	0.4	0.6			2
138	8	SPHY6094	Laser Semiconductor	2	0.2		0.8	1		2
139	8	SPHY6096	Numerical Methods	2			0.3	1.7		2
140	8	SPHY6098	Electrodynamics	2	1		1			2
141	8	SPHY6100	Relativity Physics	2			0.4	0.6	1	2
142	8	SPHY6102	Bioelectronics	2			0.2		1.8	2
143	8	SPHY6104	Signal Processing	2		0.2		0.4	1.4	2
144	8	SPHY6106	Practicum of Signal Processing	1		0.4		0.6		1
Total Weight of ILO Assessment Sample				388	76.67	98.73	95.45	65.75	51.40	388
Percentage Weight of ILO Assessment Sample					20%	25%	25%	18%	12%	100%

Things to focus on when measuring ILO achievement:

1. ILOs can be achieved from several CLOs spread across more than one course.
2. CLOs should remain the same even if the course name changes.
3. ILOs should be linked to no more than four courses to facilitate calculation.
4. The number of CLOs per course should not exceed 5, although they can be expanded with sub-CLOs.
5. CLO achievement in a single course must be distributed 100% across all types of assessments within that course.
6. A student's minimum score of >50 can be considered passing for a specific CLO.

Example of student ILO score :

NAMA : Maksatbek Kyzy Fatima (example)

NPM : 2108102010002

Sem	No	Code	Course	CPL1	CPL2	CPL3	CPL4	CPL5
I	1	SMPA1003	Introduction to Physics		10	90		
	2	SPHY1001	Practicum of Introduction to Physics	30		70		
II	3	SPHY1010	Measurement and Calibration		10	90		
	4	SPHY1012	Practicum Measurement and Calibration	30		70		
III	5	SPHY2003	Mathematical Physics 1	17.5	35	47.5		
	6	SPHY2005	Modern Physics		20	80		
IV	7	SPHY2004	Waves	10	90			
	8	SPHY2006	Practicum of Waves	30		70		
	9	SPHY2008	Electromagnetics			20	80	
	10	SPHY2010	Practicum of Electromagnetics	30		70		
V	11	SPHY3005	Statistical Physics		20	80		
	12	SPHY6005	Electromagnetic Methods	30		70		
VI	13	SPHY3030	Nuclear Physics	10	90			
VII	14	SMPAP009	Internship			17.5	35	47.5
VIII	15	SMPAPA01	Final Project	10	20		30	40
ILO Score				21.94	36.87	64.58	48.33	43.75

Notes: Calculation of ILO Value based on the weight of the course ILO to the total weight of the ILO.

Example of ILO Transcript of Students in USK Physics Study Program :

MINISTRY OF EDUCATION, CULTURE,
RESEARCH, AND TECHNOLOGY
UNIVERSITAS SYIAH KUALA
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
PHYSICS STUDY PROGRAM
Jalan Syech Abdurrauf No.3, Darussalam, Banda Aceh 23111, Building F 2nd Floor
Page: fisika.usk.ac.id, Email: fisika@usk.ac.id

TRANSCRIPT OF INTENDED LEARNING OUTCOMES (ILO)
No. 1646/UN11.1.4/3/KM/2023

Name	:	Cut Anna Faudha	Faculty	:	MIPA
NPM	:	2108102010012	Study Program	:	Bachelor in Physics
Place of Birth	:	Banda Aceh	Education Program	:	Bachelor's degree
Date of birth	:	June 11, 2004	Date of graduation	:	August 5, 2024

No	Code	Learning Outcomes	Score	Category
1	ILO – 1	Graduates demonstrate religious attitudes and good social character by applying applicable scientific norms and ethics to become lifelong learners (**S+PP**)	92	**Excellent**
2	ILO – 2	Graduates are able to master theoretical concepts in physics and multidisciplinary fields related to physical phenomena by using relevant methods to solve simple physics problems accurately and systematically (**PP**)	88	**Excellent**
3	ILO – 3	Graduates are able to master mathematical methods, computation, instrumentation, and digital technology (Internet of Things, artificial intelligence, and big data mining) by adapting and applying technology to solve interdisciplinary problems related to physics (**KK**)	80	**Good**

No	Code	Learning Outcomes	Score	Category
4	ILO – 4	Graduates are able to master applied physics concepts by applying experimental and measurement/metrology methods to disseminate information orally and in writing in accordance with standard scientific principles (**PP+KK**)	83	**Excellent**
5	ILO – 5	Graduates possess innovative, adaptive, and responsible managerial competencies, accompanied by intellectual abilities, by applying critical, logical, and independent thinking skills to work professionally and entrepreneurially (**S+PP+KU)**	87	**Excellent**

Remarks: 81 – 100 : Excellent
61 – 80 : Good
51 – 60 : Fair
<51 : Poor

Banda Aceh, August 5, 2024

Coordinator of the Study Program,

Dr. Saumi Syahreza, S.Si., M.Si

NIP. 197609172005011002

To ensure that every student graduated by the USK Study Program has met all the established Intended Learning Outcomes, the following steps are taken:

1. The Study Program sets the minimum standard of ILO graduation and the target of ILO fulfillment, as well as the criteria of ILO graduation (Excellent, Good, Fair and Poor).
2. The Study Program monitors the level of ILO achievement of students at the end of each academic year and provides recommendations for students whose ILO fulfillment has not reached the set target.
3. The Study Program issues ILO Transcripts in addition to Academic Transcripts to all graduates at the time of Judicium.

4.3 Monitoring of Learning Implementation and Evaluation of CLO Fulfillment

Monitoring of learning implementation and evaluation of CLO fulfillment is carried out as part of the PDCA cycle (Plan, Do, Check, Act) to ensure the implementation of continuous improvement. Monitoring of learning implementation emphasizes more on learning content, learning process, assessment process and

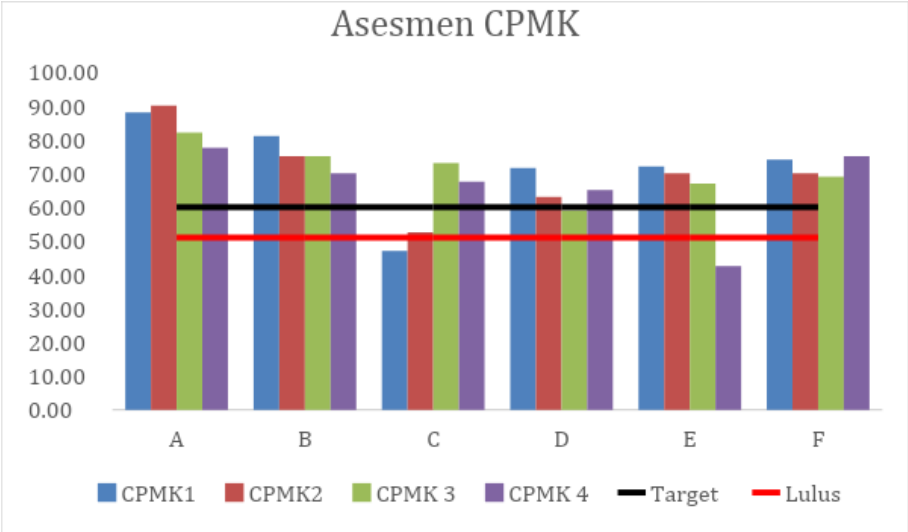
lecturer attendance. Evaluation of CLO fulfillment emphasizes on the pass rate of each CLO, the highest, lowest and average scores of students.
Monitoring of learning implementation and evaluation of CLO fulfillment is carried out in the following ways:

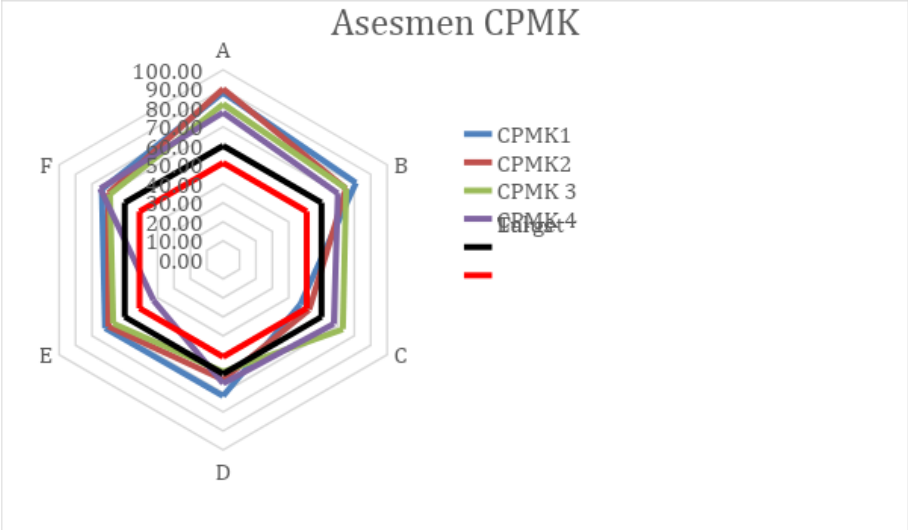
1. Each lecturer is required to make lecture control at the beginning of the lecture.
2. Each lecturer is required to take attendance at each lecture and fill in the weekly lecture monitoring sheet.
3. In one semester, lecturers conduct lectures for 16 meetings, including mid-semester exams and semester final exams.
4. At the end of each semester, students evaluate lecturers' performance by filling out an online questionnaire.
5. At the end of each semester, lecturers are required to evaluate the implementation of learning and fulfillment of learning outcomes by filling out a portfolio provided by the study program. And the results are reported to the study program for evaluation at the study program level.
6. The study program coordinator evaluates the number of lecturers' attendance, the suitability of the RPS with its implementation and the timeliness of collecting final grades.

The following is an example of evaluation and analysis of CLO Fulfillment that can be used as a reference by study programs at Universitas Syiah Kuala.

Evaluation of CLO Fulfillment:

Student Name	Assessment Item								CLO Score				ILO Score			Final Score	
	Assignment1	Assignment2	Quiz 1	Quiz 2	Exam 1 (Midterm)		Exam 2 (Final)		CPL-A	CPL-D		CPL-F	CPL-A	CPL-D	CPL-F		
	CPMK 1	CPMK 2	CPMK 3	CMPK 4	CPMK 1	CPMK 2	CPMK 3	CPMK 4	CPMK 1	CPMK 2	CPMK 3	CPMK 4				Number	Lettering
	10%	10%	15%	15%	15%	10%	10%	15%	25.0%	20.0%	25.0%	30.0%	25%	45%	30%	100%	
A	100	90	80	70	80	90	85	85	88.00	90	82	77.5	88.00	85.56	77.5	84	AB
B	90	80	75	80	75	70	75	60	81.00	75	75	70	81.00	75.00	70	75	B
C	50	60	75	80	45	45	70	55	47.00	52.5	73	67.5	47.00	63.89	67.5	61	BC
D	89	56	45	60	60	70	80	70	71.60	63	59	65	71.60	60.78	65	65	BC
E	75	60	75	45	70	80	55	40	72.00	70	67	42.5	72.00	68.33	42.5	62	BC
F	80	60	75	90	70	80	60	60	74.00	70	69	75	74.00	69.44	75	72	B
rata	80.7	67.7	70.8	70.8	66.7	72.5	70.8	61.7	72.3	70.1	70.8	66.3	72.3	70.5	66.3	69.7	


Asesmen CPMK
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
A
B
C
D
E
F
CPMK1
CPMK2
CPMK 3
CPMK 4
Target
Lulus


Asesmen CPMK
A
B
C
D
E
F
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
CPMK1
CPMK2
CPMK 3
CPMK 4
Target

CLO Fulfillment Analysis:

- The CLO passing grade for course x is set at 51 out of 100, which means that the minimum student understanding targeted is 51% of the overall learning outcomes. The lecturer targets an average class grade for each CLO of 60 out of 100 or 60% of the learning outcomes.
- The average CLO score for all students shows a score > 60 or above the target score. However, there are 2 students (approximately 33.33% of the total 6 students) who have not been able to meet the minimum CLO score set, namely CLO 1 and CLO 4 in the CPMK score column.
- The average ILO score for all students shows a score > 60. However, there are 2 students with ILO scores below the passing grade, specifically for ILO A and F in the ILO score column.
- The final average score for students is 69.7.

Controls that have been implemented

Based on the learning outcomes achieved, a further evaluation was conducted on the achievement of student learning outcomes. A special observation was conducted on two students whose CLO scores were still below the minimum target. From the observation results, it was found that both students had low midterm and final exam scores. The course coordinator also confirmed the attendance rates of both students in attending lectures. To achieve the established learning outcomes, the main challenge faced by these two students was their lack of preparation for exams involving design and calculations, as they did not bring the Thermodynamics Table materials. As a result, the students were unable to complete the exam questions effectively during the exam.

Future Control Plans

To maximize the achievement of the predetermined learning outcomes, several strategies will be implemented, including:

- Considering the online learning conditions of each student. Lecturers are advised to provide alternative learning methods as solutions for students who have problems with online learning. Exercises for design and calculation questions need to be increased in the classroom.
- Giving students the opportunity to take a remedial exam if the results of the first exam are still below the set target.

ILO assessment and evaluation are conducted by the Study Program at the end of each academic year to monitor and evaluate the achievement of ILO by each student per batch and as material for consideration and continuous improvement of the learning process in the Bachelor in Physics Study Program.